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By DANIEL FENNING, Author of the *Young Algebraist's Companion*, and *Description* and *Use of the* GLOBES, both in Dialogues.

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DEDICATION.

To the SCHOOLMASTERS of

Great-Britain and *Ireland*.

GENTLEMEN,

THE great Demand for, and ſpeedy Sale of the *firſt* Edition of this ſmall Treatiſe, naturally leads me to think, that many of you have encouraged the Undertaking.

Permit me, therefore, in this *ſecond* Edition, to return you hearty Thanks for your friendly and undeſerved Favours.

I am very ſenſible, as I told you before, that many abler Hands have undertaken this Taſk before me, and have, in large Volumes, done *that* which cannot be expected to be found here: But as you are ſenſible too many of them have ſpent their Time, rather upon Curioſities than Buſineſs, (the very Thing

that every Scholar ſhould particularly drive at, and which, I am ſenſible, every one of you would promote the Knowledge of) I have here made it my chief Care, to inform the Learner of every Thing that is neceſſary hereto.

It was not without Reluctance that I appeared upon this Subject; but having publiſhed a ſmall Treatiſe of FRACTIONS and ALGEBRA, by Way of Dialogue, in 1750, which has met with great Encouragement, I was perſuaded by ſeveral Schoolmaſters, and private Gentlemen, to publiſh alſo a Piece of ARITHMETIC, after the ſame Manner; as they were ſenſible, they ſaid, (and indeed, I confeſs, I think the ſame) that this Way of writing conveys the Matter better, and communicates Things ſooner to the Learner, than the bare ſetting of Sums, and not working them at all, or, in a dry, intricate Manner.

As I do not pretend to recommend the Work, by comparing it with other Authors; ſo, I hope, you will not condemn it, till you have peruſed it throughout.

'Tis true, that the laſt Method of reducing *C's. qrs.* and *lbs.* into *lbs.* (in the 1ſt Example of *Tare* and *Tret*) is well worthy your Obſervations, it being as eaſy as it is new; and ſeveral Perſons in Buſineſs, to whom I have communicated it, never pretend to uſe any other Way for Eaſe and Expedition.

To ſuch of you, indeed, as are perfect Maſters of the Sciences, this little Piece may appear inſignificant; but to others, I am ſenſible, the Dialogues will be of great Service, as they are intermixed with a Variety of familiar Examples, in natural Converſation: And I perſuade myſelf, they will be of great Help to your Pupils, and, in a great Meaſure, eaſe you of that heavy Taſk, which every diligent Maſter (with a Number of Scholars) muſt of Neceſſity labour under.

This, Gentlemen, is one Reaſon (as I ſaid) why I built it upon this Plan; and I hope, for the Deſign's Sake, you will forgive thoſe Errors that have yet eſcaped my Notice, and which you know are ſo common to a Work of this Sort; tho' I have taken Care to correct all ſuch, as

I have at present discovered in the first Edition.

I have corrected all those Errors that I have discovered in the first Edition, but have made no great Addition to the Work, only (by Desire of some particular Friends) have taken off Part of the Double Rule of 3 *direct* and *inverse* (as you know the Rule of 5 Numbers will supply that Defect) in Order to make more Room for some particular Method, and treat more fully of *Compound Interest* and *Cross Multiplication*, which you are sensible are far more useful and advantageous.

To my Thanks, I add my best wishes for your Success, jointly and separately, in your several Undertakings; and desires always to subscribe myself,

GENTLEMEN,

Your most obliged humble Servant,

Royal-Exchange Assurance-Office, London, June 24. 1754.

D. Fenning.

PRE-

PREFACE.

Kind READER,

I Here present you with the second Edition of my small Treatise of ARITHMETIC, which I have improved and endeavoured to render as plain as Time, Room, and Opportunity would admit of.

For such of you, who have hitherto too much neglected this Branch of Education; and for others, who have neither Time, nor Opportunity, to apply to a proper Master, the following Work was chiefly designed; and was at first carried on no farther than the *Rule*

of Three Direct: But I considered with myself, that it might fall into the Hands of many, who would be glad to have a Notion of *Fractions*. I have, therefore, to serve you, treated upon most of the Rules of *Arithmetic*, and for the Sake of those that live in the Country in particular, I have given some Instructions to measure Timber, or a common Piece of Ground; as also, to gauge a Cask, or Piece of Malt, and several other useful and practical Examples, which, I am persuaded, will be of Service to you.

One Thing, which is seldom taken Notice of in a PREFACE, I would have every one of you, that are Learners, to observe, and that is, That if, upon the Trial of any Sum, or Question, you do not find it the same as the Answer, do not let that discourage you; for if you examine your own Work after you have done it, and are so much Master of the Rules as to know when you are right or wrong; you may conclude you are right, whatever Answer you may find in my Work, or any other Author's: But before you determine this, mind and be sure your own Work is right.

As to such of you that have little or no Notion of Figures, if you have a Mind to learn, I am sensible you may very easily do it, with little or no Trouble; for I have taken the

the more Pains, that you might have the lefs: And if it does but anfwer the End of inftructing fuch of you as are quite ignorant, and improving others that have already fome Knowledge of Figures, I fhall look back upon the Undertaking with Pleafure, notwithftanding thofe mean Criticifms and Remarks, that may be made upon fuch Overfights, which can hardly be avoided in a Work of this Sort.

But, every impartial Reader will confider the Nature and Defign of the Work: For 'tis the Plan upon which it is built that is to be minded: If *this* be plain and eafy (as I hope it is) there is no Fear but the Learner will find a fenfible Satisfaction, and the Work be crowned with Succefs. As for fuch *Carpers* that are refolved to amufe themfelves with the Bone only, they are extremely welcome; but let them be civil, and not fnarl at thofe that would eat the Flefh quietly. I am,

Kind READER,

Your Humble Servant,

and Well-wifher,

London, June 24, 1754.

Daniel Fenning.

TO THE

PUBLICK.

WE whose Names are hereunto ſubſcribed, having peruſed the Plan of this little Treatiſe of ARITHMETIC, do allow the Dialogues to be very well adapted to the Purpoſe: And as the Rules and Examples are laid down in a natural, eaſy, and familiar Manner, WE beg Leave to recommend it, as the moſt uſeful and eaſy Book for Learners extant.

Edmund Anguiſh, *Accomptant*
James Barclay, *Writing-Maſter*
William Bently, *Surveyor*
George Coles, *Ditto*
Henry Deacon, *Accomptant*
Randall Evans, *Writing-Maſter*
Anthony Gilbert, *Surveyor*
Edward Griffiths, *Ditto*
Samuel Hill, *Philom.*
Thomas Humphreys, *Writing-Maſter*
Thomas Hughes, *Ditto*
Samuel Hornby, *Ditto*
Timothy Langley, *Accomptant*
Abraham Longden, *Ditto*
Abraham De Lire, *Philom.*

Thomas

Thomas Newberry, *Philom.*
John Quant, *Writing-Maſter*
William Richardſon, *Ditto*
David Rowland, *Accomptant*
John Smyth, *Writing Maſter*
James Smith, *Ditto*
Thomas Smithe, *Ditto*
John Smythe, *Accomptant*
Zachary Snaper, *Ditto*
Eraſmus Turner, *Ditto*
Johnſon Thompſon, *Writing Maſter*
James Thurſton, *Ditto*
Daniel Trunker, *Ditto*
William Thorley, *Ditto*
James Thorpe, *Ditto*

To the RECOMMENDERS.

GENTLEMEN,

I Return you hearty Thanks for the Honour you have done me, by the Favour of your Names to this little Treatiſe: Let me crave your further Aſſiſtance in noting down thoſe Errors that you may occaſionally find, and you will ſtill further oblige,

GENTLEMEN,

Your very humble Servant,

June 24, 1754.

Daniel Fenning.

P. S. Gentlemen are taught the Uſe of the Globes, at their own Houſes, by the Author.

THE

THE INTRODUCTION.

CHAP. I.

DIALOGUE I.

Between PHILO, *a Tutor, or Master*; *and* TYRO, *a young Scholar*; *cancerning the Rudiments of* ARITHMETIC.

TYRO *visits* PHILO.

Tyro. DEAR Sir, I am your very humble Servant —— You will pardon me, I hope —— I hear you have done instructing *Tyrunculus*, and I am come to lay claim to a former Promise, of your giving me a better Notion of common *Arithmetic*.

Philo. You please me very much, young *Tyro*, I assure you, to see you so willing to learn; but I hear you understand the first four Rules already.

Tyro.

Tyro. When I was at School I had ſome Knowledge of them, as I thought; but it was not well-grounded; and when I left School, inſtead of practiſing at Home, and making myſelf Maſter of what I learnt there, I bent my Mind to Play and Idleneſs, like other naughty Boys; and were it not for your kind Offer, I ſhould know the Want of it too late. I chooſe therefore, Sir, to begin at the very loweſt Branch, that I may ſee the Reaſon of what I am doing, and not learn by Rote, as too many School-boys do, to the great Diſcredit of their Maſter, Grief of their Parents, and their own future Ruin.

Philo. You ſay very right; for in beginning again you will be confirmed in what you know already; for I ſhall proceed with you the ſame as if you never had began, that others may be the better informed; therefore, for their Sakes, do not you be angry, if I ſhould dwell upon ſome Things longer than you may think there is Occaſion for, ſince I tell you the Reaſon beforehand.

Tyro. Far be it from me, Sir, to take it amiſs; for though I do know ſomething of the firſt four Rules, I am ſenſible there are many Thouſands who know Nothing of the Matter, and you do well to conſider them alſo.

Philo. I am glad, *Tyro*, to ſee you ſo conſiderate; it gives me great Hopes of your being Maſter of what I am about to inſtruct you in.

DIALOGUE II.

SECTION I.

Of NUMERATION, ADDITION *of* Whole Numbers, Money, Weights, *and* Meaſures, *&c.*

Tyro. WHAT is *Numeration,* and what does it teach?

Philo. Numeration is the true Diſtinction and Pronunciation of Number; that is, it teaches us to write down, read, and expreſs any Number or Numbers whatſoever: For the better underſtanding of which, obſerve the following Table.

N. B. The Letter C ſtands for an Hundred, and X for Ten.

TABLE.

	C of Millions.	X of Millions.	Millions.	C of Thouſands.	X of Thouſands.	Thouſands.	Hundreds.	Tens.	Units.
Places	9	8	7	6	5	4	3	2	1
	9	8	7	6	5	4	3	2	1
		9	8	7	6	5	4	3	2
			9	8	7	6	5	4	3
				9	8	7	6	5	4
					9	8	7	6	5
						9	8	7	6
							9	8	7
								9	8
									9

NOTE I.

This TABLE you ought to get by Heart, at leaſt, ſo as to underſtand the Nature of it.

Caſt your Eye now *Tyro* upon it; you ſee that there are nine Places of Figures from Units

to Hundreds of Millions. All the Figures under the firſt Row are Units; thoſe in the ſecond Row towards the Left-Hand, are under the Place of Tens; all in the third Row are called Hundreds; thoſe in the fourth Row Thouſands, *&c.*

Now, in Order to know the Value of, or how to expreſs any Number in the Table, I begin at the top Figure, towards the Right-hand, and ſay Units; (1) then Units, Tens, (Twenty-one, 21;) then Units Tens, Hundreds, (three Hundred and Twenty-one, 321:) Thus I go on, and find the fourth Figure (*viz.* 4) under the Place or Name of Thouſands, and accordingly, I call it four Thouſand, which, joined to the other three Figures, will be four Thouſand, three Hundred, and Twenty-one, 4,321. The fifth Figure being in the Place of Tens of Thouſands, is thus read: Fifty-four Thouſand, three Hundred, and Twenty-one, 54,321. Thus proceed till you come to the laſt Figure of all, towards the Left-hand, (which ſtands in the Place of Hundreds of Millions) and you will eaſily perceive, that thoſe nine Figures are thus expreſſed: Nine Hundred, eighty-ſeven Millions, ſix Hundred, fifty-four Thouſand, three Hundred, and Twenty-one, 9,87,654,3,21. Read this once more, and obſerve the Comma's, or Stops, that are put to the Figures; for they anſwer to, or correſpond with, the Stops in the Words that are written out at Length.

NOTE 2.

You are further to obſerve, *Tyro*, that the *Numeration-Table* is not always ſet with theſe Figures juſt in the Form they here ſtand; for had they been any other nine Figures, they are numbered and expreſſed after the ſame Manner: For Inſtance, ſuppoſe they were 1,2,3,4,5,6,7,8,9, this is expreſſed after the ſame Manner, only inſtead of 987 Million, it is now 123 Million; inſtead of 654 Thouſand, it is here 456 Thouſand; and inſtead of 321, it is now 789. So alſo,

999,999,999 is read thus: Nine hundred, ninety-nine Million, nine hundred, ninety-nine Thouſand, nine Hundred, and Ninety-nine, &c. So that you ſee it is only having a due Regard to the Places under which the Figures ſtand; for after the firſt three Places of Figures (*viz.* Unit, Tens, and Hundreds) the next three Places have the Name of Thouſands, the next three the Name of Millions, as you may obſerve by the following Table, which, I believe, will be of Service.

TABLE 2.

Millions Place.	Thouſands Place.	Hundreds.	Tens.	Units.
1 2 3.	4 5 6.	7	8	9
1 2.	3 4 5.	6	7	8
1.	2 3 4.	5	6	7
	1 2 3.	4	5	6
	1 2.	3	4	5*
	1.	2	3	4
		1	2	3
			1	2
				1

Now here you ſee they are divided by Stops, or Periods, which is certainly a Help to the expreſſing the Numbers: Thus, Suppoſe I would expreſs the Number againſt which this Mark (*) is placed. I find the *Twelve* ſtands under the Place of Thouſands, ſo that I ſay it is twelve Thouſand, three Hundred and Forty-five, &c.

Tyro. I perceive it, Sir, very plainly: But, pray what Uſe are Cyphers of; or are they of no Signification?

Philo. Cyphers are of no Signification, when they ſtand alone, (thus 000, or 0000, all ſtand for Nothing: Nor are they of any Signification placed before any Figure or Figures, thus, 02 is but 2; and 0005 is but 5 ſtill: But when

when Cyphers are put after Figures, it makes the Number ten, twenty, thirty, a hundred, or a thousand Times more in Value. Thus 1, by adding a Cypher, is (10) Ten, add two Cyphers, thus, 100, it is an Hundred, &c. as by the following Table.

TABLE 3.

1	One.
10	Ten
100	An Hundred.
1000	A Thousand.
10000	Ten Thousand.
100000	An hundred Thousand.
1000000	A Million.
10000000	Ten Million.
100000000	An hundred Million.
1000000000	A thousand Million.
10000000000	Ten thousand Million.
100000000000	An hundred thousand Million.
1000000000000	Millions of Millions.

And thus you may go on as far as you please.

Tyro. I perceive it; but who could tell the Value, or express so many Figures out of the Course of the Table?

Philo. You talk like a Learner indeed. You see the twelfth Figure, by the above Table, has the Name of an hundred thousand Millions; therefore, were there 3, 4, or 5 Times, or 5 hundred Times as many Figures, it would be as easy to number them in Order, as well as if there were but 5 in all.

Tyro, That is a little surprising to me, I confess; for some think they do great Things, to number 9 or 10 Figures only.

Philo Well, *Tyro,* we will not call that Pride altogether; for Pride is good in Learners, so far as tends to Emulation only; that is, an earnest Desire to excel in Learning: But, pray observe, Suppose I had ever so many

many Figures to number; you plainly see, by the last Table, that the seventh Figure is Millions Place, and that the thirteenth Place has the Name of Millions of Millions; so also the nineteenth Figure would be Millions of Millions of Millions: But as the Word Millions would be repeated so often in a very large Number of Figures, as to render it tiresome, there is a shorter and much easier Way of expressing the Number by certain Words, which answer to every seventh Figure, and to any Degree of Millions, as appears by the following Table.

TABLE 4.

Dots.	The 7th Figure from the Units Place is Millions.
1	13 is Bimillions, or Millions of Millions.
2	19 is Trimillions, or the 3d Deg. of Millions.
3	25 is Quartrillions, or the 4th Deg of Millions.
4	31 is Quintillions, or the 5th Deg. of Millions.
5	37 is Sexquillions, or the 6th Deg. of Millions.
6	43 is Septillions, or the 7th Deg. of Millions.
7	49 is Octillions, or the 8th Deg. of Millions.
8	55 is Nonnillions, or the 9th Deg. of Millions,
9	or Millions 9 Times repeated, *&c.*

Suppose it were required to number the 57 following Figures, 321, 987, 654, 321, 987, 654, 321, 987, 654, 321, 987, 654, 321, 987, 654, 321, 987, 654, 321.

Here I make a Period or Dot over every 7th Figure, and find there are 9 Dots in all: Then searching in the above Table, I find the 9th Dot to bear the Name of Nonnillions, the 8th of Octillions, *&c.* Therefore, I number the above Figures thus; three Hundred 21 Nonnillions, 987 Thousand; 654 Octillions, 321 Thousand; 987 Septillions, 654 Thousand; 321 Sexquillions, 987 Thousand; 654 Quinquillions, 321 Thousand; 987 Quartrillions,

Quartrillions, 654 Thousand; 321 Trimillions, 987 Thousand; 654 Bimillions, 321 Thousand; 987 Million, 654 Thousand, 321. And thus you may go on to as many more Places, *&c.* Or you may number them by the second Part of the Table, and that is, by putting small Figures where the Dots stand, as 1, 2, 3, 4, till you come to 9: Then begin, and say $32\overset{9}{1}$ of the 9th Degree of Millions, 987 Thousand; $65\overset{8}{4}$ of the 8th Degree of Millions, *&c.* till you come to the End: And thus, by putting small Figures over every 7th Figure, you may number to to the 20th, 30th, or any higher Degree of Millions whatsoever.

Tyro. I understand you well; and though it is likely there may never be so many Figures in any Sum; yet, it is good to know how to number them when a Question is asked, though it be for Fancy's Sake only. But now, *Philo*, if you please, I will ask you a few Questions, which I am at a Loss to know.

Quest. 1. How is *eleven Thousand, eleven Hundred,* and *Eleven,* set down in 5 Figures?

Philo. I know this is a common Question, and it is easily done, if you consider; for this is the Answer 12,111, *viz.* twelve Thousand, one Hundred, and Eleven.

Proof by ADDITION.

$$\left.\begin{array}{rr} \text{Eleven Thousand is} & 11{,}000 \\ \text{Eleven Hundred is} & 1{,}100 \\ \text{Eleven is} & 11 \end{array}\right\}\text{add}$$

$$\begin{array}{r} \hline 12{,}111\text{, as above.} \end{array}$$

Quest. 2. How is *fifteen Thousand, fifteen Hundred,* and *Fifteen,* set down in five Figures? *Answer,* 16,515

But you are to observe, *Tyro,* that though these Oddities are easily answered you see; yet, I would not have you be concerned with them; because they are very badly

badly expreſſed, and are an Abuſe of Language: For, ſuppoſe you ſtood indebted to me, and ſhould aſk me what it was, and I ſhould ſay *fifteen Pounds, fifteen Shillings*, and *fifteen Pence*; would you not think it much better to ſay *fifteen Pounds, ſixteen Shillings, and three Pence?* Take this then for a Rule, *Tyro*, that *that* is the beſt Method of Expreſſion; that is, the ſhorteſt, freeſt, and moſt natural. Therefore, tho' the aforeſaid Numbers run a little ſmoother in Words than what I have now mentioned, (the Reaſon of which is, becauſe they are each but one whole Number) yet is the Senſe of expreſſing *fifteen Thouſand, fifteen Hundred, and Fifteen*, very little better than *fifteen Pounds, fifteen Shillings, and fifteen Pence.*

☞ Now there are ſeveral Things a little dark in Expreſſion, relating to Numbers, which are actually of Uſe when they are known. I imagine, *Tyro*, you now and then read good Books: You remember we read in the Book of *Kings*, and in *Iſaiah*, that an Angel deſtroyed, in the Camp of the *Aſſyrians*, an Hundred, and Fourſcore, and five Thouſand. How do you ſet this down properly?

Tyro Why really, Sir, I am at a Loſs; and have ſeen older Perſons than myſelf puzzled at it.

Philo. So have I; but it muſt be for Want of conſidering. Is not Fourſcore and five the ſame as 85. Therefore, the Number is one Hundred, eighty-five Thouſand, thus, 185,000.

Again, you read in the *Revelations*, of a Multitude of ten Thouſand Times ten Thouſand; which is 1,00000000, *viz.* one Hundred Million: And a little further, you read of another, conſiſting of two Hundred Thouſand Thouſand, which is, 200,000000 Million, *viz.* two hundred Million, which you will ſee demonſtrated, ***Example*** the 3d and 4th in Compendiums of *Multiplication.*

I ſhall finiſh *Numeration* with ſome of the old *Roman* Numbers, as it may be of Service.

A TABLE

A TABLE *of Old* ROMAN *Numbers.*

L. ſignifies, or ſtands for (50) Fifty.
C. for an (100) Hundred.
CC. (200) Two Hundred.
CCC. (300) Three Hundred.
CCCC. (400) Four Hundred.
D. ſignifies (500) Five Hundred, or thus IↃ·
DC. ſtands for Six (600) Hundred, or thus IↃC.
DCC. (700) Seven Hundred, or thus IↃCC.
DCCC. (800) Eight Hundred, or thus IↃCCC.
DCCCC. (900) Nine Hundred, or thus IↃCCCC.
M. (1000) A Thouſand, or thus CIↃ·
MM. (200) Two Thouſand, *&c.*

ROMAN *Numbers explained by* FIGURES.

DL. 550.
DCCX. 710.
MDXIV. 1514.
MDCLI. 1651.
MDCCIX. 1709.
MDCCLIII. 1753, *&c.*

And now, *Tyro*, we will proceed to *Addition*.

SECTION II.

Of ADDITION.

Tyro. WHAT do you mean by *Addition?*

Philo. *Addition* ſignifies the *gathering*, *collecting*, and *adding* together, two, or more Numbers into one Sum.

Tyro. How many Parts are there in *Addition?*

Philo. Two, *ſimple* and *compound.*

Tyro. What is *ſimple Addition?*

Philo.

Philo. Simple Addition is that which consists of one *simple* or *single* Name; that is to say, of *whole Numbers* only, as *Pounds Sterling, Tons, Yards, Ells,* or *Ounces, &c.* For Ten is Ten, and a Thousand is a Thousand, in any Number and Quantity; tho' the Quality or Name be different; and they are all added by one Rule, namely, by casting out the Tens, and setting down in every Line what is over Ten, as you will see by and by.

Tyro. What does *Compound Addition* consist of?

Philo. Of *Money, Weights,* and *Measures, viz. Averdupois-Weight, Troy-Weight, Apothecaries,* and *Goldsmiths-Weight,* &c. Likewise, *Dry-Measure, Liquid-Measure, Cloth-Measure, Square-Measure, Long-Measure, Land-Measure,* and *Time.* Of these in their Order.

SECTION III.

ADDITION *of whole Numbers.*

THE Rule to be got by Heart is,

For every Ten in the Units Place, or first Row of Figures, you must carry one to the Tens Place, or second, Row, and so proceed; because Ten Units make Ten, Ten Tens an Hundred, and Ten Hundred a Thousand.

The EXPLANATION.

First, If there be but one Row of Figures, you must set down under the Row what it comes to, and if it amounts to 2, or more Figures, set the first under the Row, or Sum; and the other Figure, or Figures, set to the left Hand of the first Figure.

See the following Examples.

Add

Add	2	3	2	9
	1	2	1	7
	1	1	4	8
	5	2	3	and 4 together.
	—	—	—	—
	9 *Anſ.*	8 *Anſ.*	10 *Anſ.*	28 *Anſ.*

Here I ſay 5 and 1 is 6, and 1 is 7 and 2 is 9; which I place under the Numbers, and it is done: But to prove whether it be right, I begin at the Top, and caſt it downwards, and find it comes to the ſame.

Secondly, If it amounts to juſt Ten and no more (as in *Example* 3) ſet it down as before; only ſet the Cypher under the Row, and ſet the Figure of 1 out towards the Left-hand. So alſo, in *Example* 4, I find it amounts to 28, which I ſet under the Row, *viz.* the Units 8 under the Row itſelf, and the 2 towards the Left-hand in the Place of Tens.

Thirdly, When you have two or three Rows of Figures, then, according to the Rule, add up the firſt Row, or Units Place, and obſerve how many Tens it contains, and if it comes juſt to even Tens, ſet a Cypher underneath, and carry as many *Ones* to the next Row as there were *Tens* in it; that is, if it be 20, carry 2, if it be 30, carry 3, if 40, carry 4, and for 50, carry 5, *&c.* And the laſt Row of all ſet down what it amounts to, as if it were one ſingle Row only.

An EXAMPLE *at large.*

Add	87625	Pounds
	94915	
	62194	
	76547	
	81965	
	92198	
and	71964	together.
	567408	*Anſ.*

Now

Now obſerve once for all. I begin, and ſay, 4 and 8 is 12, and 5 is 17, and 7 is 24, and 4 is 28, and 5 is 33, and 5 is 38; this is the Amount of the firſt Row, or Units Place, but I muſt not ſet down the whole 38, but ſee how many Tens it contains, and find it to be 3 Tens, and 8 over; this 8 I ſet under the Row, and carry 3 to the next Row, or Tens Place, ſaying, 3 that I carry and 6 is 9, and 9 is 18, and 6 is 24, and 4 is 28, and 9 is 37, and 1 is 38, and 2 is 40: This being juſt 4 Tens, I ſet down a Cypher, and carry 4 for the 4 Tens to the next Row, or Hundreds Place, ſaying, 4 and 9 is 13, *&c.* and I find the third Row to be 44, which is 4 Tens and 4 over; therefore, I ſet down 4, and carry 4 to the fourth Row, or Place of Thouſands, and find that it amounts to 27, then I ſet down the odd 7, and carry 2 to the fifth, or laſt Row, and find that it amounts to 56, and becauſe this is the laſt Row I ſet down the whole 56, that is, the 6 under the Row, and the 5 to the Left-hand.

Fourthly, When there are ſeveral Numbers to be added together, conſiſting ſome of fewer and ſome of more Figures, they are added after the ſame Manner as before, only obſerve, in ſetting down the Numbers on your Slate, or in a Book, that you be careful to ſet Units under Units, Tens under Tens, or elſe you will be puzzled in caſting them up.

Ex. 6. Suppoſe I were to add 3417, 26, 184, 9, 271, and 3 together: I ſet them down as follows, which will be a ſtanding Rule for any Thing of the like Nature.

EXAMPLE 6.

Loads.
3417
26
184
9
271
3
3910

Here you see I set Units under Units, and Tens under Tens, and then I cast up from Row to Row as before directed.

Tyro. I understand it very well; but I should have set it down thus, with Cyphers, to supply the vacant Places.

3417
0026
0184
0009
0271
0003
3910

Philo. It is quite superfluous; for you have been told already, that Cyphers before Figures do not at all increase the Value: Besides, it is neither so sightly, nor advantagious to cast up, nor are they seldom or ever used by Accomptants, even in Addition of Money, to fill up any Line or Space whatsoever, as you will see in *Example* 13 of *Addition of Money*.

More Examples in Whole Numbers.

Bushels.	*Ells.*	*Yards.*
471756	6715	65432
434176	46	2145
621985	9	234
942176	2176	67
354219	200	8
471625	6	76
982196	10	354
853294	1756	3256
	1	76258
5131427	10919	147830

And

And now, *Tyro*, I will ſet you two or three Queſtions by Way of Exerciſe.

Questions *to exerciſe* Addition *of Whole Numbers.*

Queſt. 1. From *London* to *Rumford* is 11 Miles, from *Rumford* to *Brentwood* 6, from *Brentwood* to *Chelmsford* 11, from *Chelmsford* to *Witham* 8, from *Witham* to *Kelvedon* 4, from *Kelvedon* to *Colcheſter* 10, from *Colcheſter* to *Manningtree* 9, and from *Manningtree* to *Harwich* 12: How many Miles then is it from *London* to *Harwich?*

Anſwer. 71.

Tyro. I apprehend the Queſtion; it is only ſetting down the Numbers as they ſtand in their Order, as under.

	Miles.
From *London* to *Rumford*	11
From *Rumford* to *Brentwood*	6
From *Brentwood* to *Chelmsford*	11
From *Chelmsford* to *Witham*	8
From *Witham* to *Kelvedon*	4
From *Kelvedon* to *Colcheſter*	10
From *Colcheſter* to *Manningtree*	9
From *Manningtree* to *Harwich*	12
From *London* to *Harwich*	71 *Anſ.*

Queſt. 2. A Farmer has 7 Fields, containing the following Acres, *viz.*

	Acres.	
In one Field are	25	How many Acres are there in all? *Anſ.* 192.
In another	57	
In another	18	
In another	25	
In another	15	
In another	43	
In another	9	

Anſ. 192 Acres.

Quest. 3, A Draper has 6 Pieces of Cloth as under.

		Yards.	
* N°. 1	Containing	87	How many Yards are there in all? *Anf.* 210.
2	——— ———	45	
3	——— ———	17	
4	——— ———	8	
5	——— ———	32	
6	——— ———	21	
		——	

Anf. 210 Yards.

Quest. 4. How many Days are there in the Year, or in the 12 Calendar Months? First, set them down as follows:

		Days.
First,	*January* has ——— ———	31
	February ——— ———	28
	March ——— ———	31
	April ——— ———	30
	May ——— ———	31
	June ——— ———	30
	July ——— ———	31
	August ——— ———	31
	September ——— ———	30
	October ——— ———	31
	November ——— ———	30
	December ——— ———	31
		——

Note, Every fourth Year is called *Leap-Year*, and has 366 Days; *February* having then 29 Days.

Anf. 365 Days.

* *Note*, That in marking of any Sort of Goods N°. stands for Number.

Quest.

Quest. 5. How far is it from *London* to *Carlisle* in *Cumberland*, when,

	Miles.
From *London* to *Newcastle* is	149
From *Newcastle* to *Preston*	62
From *Preston* to *Lancaster*	21
From *Lancaster* to *Penrith*	50
From *Penrith* to *Carlisle*	19

Ans. 301 Miles.

Tyro. I understand what you have shewn me very well.

Philo. Then I shall only leave one Question more for you to try at your Leisure.

Add 47, 697, 5, 91707, 100000, 263001**75**, 500, 62, and 987654321 together? *Ans.* 1014147514.

To prove ADDITION.

Tyro. How do you prove *Addition?*

Philo. Two Ways. *First,* When you have cast up any Sum, as before directed, then begin at the Top, and cast downwards instead of upwards; and if the Figures come the same, no Doubt but the Work is right: Besides, in Things which require Care, you should make a Practice of casting every Line, first upwards, and then downwards.

The *second* Way is very well for Learners, but too tedious for Business; but as it is customary in Schools to teach it, I shall shew you the Method, which is as follows.

Let us take *Quest.* 4, which amounts to 301 Miles; and to prove whether this be right, I cut off the Top Line of Figures by a Stroke with the Pen, thus—

149

62
21
50
19

---

301 *Anf.*

---

152 Add this to the Top 149.

---

301 *Proof.* See *Addition of Money.*

Then I begin to caſt up the Sum again, as I did at firſt, only inſtead of going to the Top of all, I now, this ſecond Time, caſt no further than the 2, (leaving out all the Figures that are cut off, or that ſtand above the Line) and find it amounts to 12, which is 2, and I carry 1; then I proceed to the ſecond Row, and find it amounts to 15; ſo that this amounts in all to 152, which I place under the 301. *Laſtly*, I add this middle Line 152 to the top Line 149, and find that they make juſt 301, which proves the firſt Work to be right. I ſhall give you a further Reaſon, when you come to Examples of *Money*, why this Way is not ſo fit for Practice in Buſineſs as caſting the Sum upward and downward. And now we will proceed to

SECTION IV.

ADDITION *of* MONEY.

Tyro. WHAT is neceſſary to the Learning of *Addition of Money?*

Philo. Theſe three Things: *Firſt*, the Rule; then the Characters; and *thirdly*, Pence-Tables; all which ſhould

ſhould be perfectly got by Heart before you pretend to caſt up Money.

1. *The* RULE.

For every 4 Farthings carry 1 Penny to the Pence; for every 12 Pence carry 1 Shilling to the Shillings; and for every 20 in the Shillings carry 1 to the Pounds, which are caſt up by Tens, as in *whole Numbers*.

2. *Of the Common* Characters.

Note 1. £. ſtands for Pounds, S ſtands for Shillings. *D* ſtands for Pence. Or thus, £. *s. d.* Pounds, Shillings, Pence.

Note 2. A Farthing is one fourth Part of a Penny, and is thus ſet down $\frac{1}{4}$. An Half penny is one Half, and is thus ſet down $\frac{1}{2}$. Three Farthings being three Fourths, is thus ſet down $\frac{3}{4}$.

Note 3. 1 Quarter, 1 Half, and 3 Quarters are alſo ſet thus, $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$.

3. *Of* Pence-Tables.

Table 1.

Pence.		*s.*		*d.*
20		1	—	8
30		2	—	6
40		3	—	4
50		4	—	2
60	is	5	—	0
70		5	—	10
80		6	—	8
90		7	—	6
100		8	—	4
110		9	—	2
120		10	—	0

Table 2.

Pence.		*s.*
12		1
24		2
36		3
48		4
60	is	5
72		6
84		7
96		8
108		9
120		10

By

By the Help of theſe two Tables, the firſt encreaſing by Tens, or every 10 Pence; and the other by even Shillings, or every 12 Pence, you will ſoon caſt up any ſmall Sums, by a due Regard to the following Examples.

Tyro. But I hope, Sir, you will give me an Example in Length, by explaining it in Words; for that will be of more Service to me than an hundred Examples without Explanation.

EXAMPLE 1.

	£.	s.	d.	
Add	9	4	2	
	8	5	3	
and	7	9	6	together
	24	18	11	

EXAMPLE 2.

	£.	s.	d.	
add	41	3	8	
	62	9	7	
and	47	11	6	together
	151	4	9	

EXAMPLE 3.

	£.	s.	d.	
Add	95	16	2	
	68	14	10	
and	49	12	11	together.
			*	

Philo. You ſeem to be timerſome, and doubt your own Abilities without Occaſion. Come, pray try at the firſt Sum?

Tyro. I ſee plainly how you do *that*, becauſe the Pence all added together do not exceed 12, nor the Shillings do not exceed 20; therefore, I ſet the Amount of them under the Row to which they belong, and find the Total to be twenty-four Pounds, eighteen Shillings, and eleven Pence.

* I leave *Example* 3 undone for your Practice, and will give you another Table for the more eaſily caſting up the Shillings.

Philo.

Philo. The ſame is to be obſerved in *Ex.* 2. Thus I ſay, 6 and 7 is 13, and 8 is 21 Pence. Now, by the 1ſt *Table*, 20 Pence is 1 *s.* 8 *d.* therefore, 21 Pence muſt be 1 *s.* 9 *d.* Or by the 2d *Table*, I aſk how many Times 12 I can have in 21 *d*, and find it 1, and 9 over; therefore, I ſet the odd 9 down under the Place of Pence, and carry 1 to the Shillings, ſaying, 1 that I carry and 11 is 12, and 9 is 21, and 3 is 24 Shillings. Now, as 20 *s.* make a Pound, 24 *s.* is 1 *l.* 4 *s.* therefore, I ſet the 4 under the Shillings, and carry one to the firſt Row of the Pounds, caſting them up as in *Addition of whole Numbers*, and find it 151 *l.* So is the Total 151 *l.* 4 *s.* 9 *d.*

TABLE 3.

Shillings,		Pounds.	*s.*
20	is	1 –	
30		1 –	10
40		2 –	
50		2 –	10
60		3 –	
70		3 –	10
80		4 –	
90		4 –	10
100		5 –	

Pleaſe to add up the following Sums.

EXAMPLE 4.	EXAMPLE 5.	EXAMPLE 6.
£. *s.* *d.*	£. *s.* *d.*	£. *s.* *d.*
45 – 9 – 9	249 – 3 – 10	652 – 5 – 8
94 – 5 – 8	176 – 5 – 8	652 – 5 – 8
76 – 7 – 10	649 – 8 – 10	652 – 5 – 8
51 – 8 – 9	148 – 7 – 5	652 – 5 – 8
25 – 7 – 6	219 – 5 – 7	652 – 5 – 8
75 – 5 – 11	154 – 7 – 9	652 – 5 – 8
368 – 5 – 5		

Tyro. I begin at at the Row of Pence, and find that it amounts to 53. Now, according to my *first Pence-Table*, 50 Pence is 4 *s.* 2 *d.* therefore, 53 Pence is 4 *s.* 5 *d.* Or by *Table* 2, I find how many 12 Pences I can have in 53 Pence, and find that 4 Shillings is 48 Pence, therefore, 53 *d.* must be 4 *s.* 5 *d.* which odd 5 Pence I set down under the Row of Pence, and carry the 4 Shillings to the Row of Shillings, and find it amounts to 45. Now, by *Table* 3, I find 45 *s.* to be 2 *l* 5 *s.* which odd 5 *s.* I put under the Shillings, and carry 2 *l.* to the Pounds, which I cast up as in *Whole Numbers* (by Tens) and find the *Total*, or whole Amount, to be 368 *l.* 5 *s.* 5 *d.*

Philo. Very well; but now you have done it, pray let me hear you say what it comes to? For I have known many School-Boys not able to read what they write or cast up.

Tyro. 'Tis very true, Sir, but I think it is three hundred and sixty eight Pounds, five Shillings, and five Pence.

Philo. Very right; and I make no doubt by your careful Proceeding, but you will understand the first four Rules of *Arithmetic* in a short Time. I leave *Example* 5 and 6 undone, for you to try, at Leisure, after the same Way and Manner. And now I will try you with an Example or two with Farthings.

EXAMPLE 7.			EXAMPLE 8.			EXAMPLE 9.		
£.	s.	d.	£.	s.	d.	£.	s.	d.
47	8	$4\frac{1}{2}$	271	7	$6\frac{3}{4}$	278	4	3
15	5	10	146	5	$8\frac{1}{4}$	164	8	$9\frac{1}{2}$
17	4	$8\frac{1}{2}$	956	8	3	215	1	10
49	9	$6\frac{1}{4}$	178	7	$8\frac{3}{4}$	464	5	$4\frac{1}{4}$
15	10	7	246	9	$7\frac{1}{4}$	176	7	$8\frac{1}{2}$
14	7	$9\frac{3}{4}$	101	6	5	291	3	5
97	3	$5\frac{3}{4}$	247	8	$3\frac{1}{2}$	456	7	$6\frac{3}{4}$
14	9	6	604	9	$8\frac{3}{4}$	278	5	7
Ans. 270	19	$9\frac{3}{4}$						

Tyro.

Tyro. I can do these as well as the other. *First*, I begin with the Farthings, saying, 3 and 3 is 6, and 1 is 7, and 2 is 9, and 2 is 11 Farthings, that is, 2 *d.* and 3 Farthings over, which 3 Farthings I set under the Row of Farthings (thus $\frac{3}{4}$) and carry 2 Pence to the Pence, and find they amount to 57 Pence, which is 4 *s.* 9 *d.* This odd 9 I set under the Pence, and carry 4 to the Shillings, and find them 59, that is, 2 Pounds, and 19 over, which 19 I set under the Shillings, and carry 2 to the Pounds, I find them come to 270: So is the Total or Answer 270 *l.* 19 *s* 9 *d.* $\frac{3}{4}$.

Philo. Very well done indeed: Proceed in the same Manner, and you will find *Ex.* 8. to be 2752 *l.* 3 *s.* 3 *d.* $\frac{1}{4}$.

Tyro. I am obliged to you, Sir, and now I should be glad you would give me Instructions how you manage *double Figures* in the Shillings.

Philo. I will shew you three or four different Ways, and you may take that which appears most natural and easy.

4. *Of casting up* double Figures *in the Shillings, such as* 16. 18. 17. *or the like.*

EXAMPLE 10.			EXAMPLE 11.			EXAMPLE 12.		
£.	s.	d.	£.	s.	d.	£.	s.	d.
64	17	$10\frac{1}{4}$	756	17	8	4715	11	$10\frac{2}{2}$
47	14	11	175	16	$11\frac{1}{4}$	1762	14	5
67	18	$10\frac{3}{4}$	476	11	$9\frac{1}{2}$	6471	14	$6\frac{3}{4}$
55	17	$8\frac{1}{2}$	187	17	10	1754	15	$11\frac{1}{4}$
49	19	11	256	19	$5\frac{3}{4}$	6474	19	8
64	15	5	175	14	$11\frac{1}{4}$	1762	17	6
351	04	$8\frac{1}{2}$						

METHOD 1. I cast the Farthings up (first upwards and then downwards) and find them 6, I therefore set down $\frac{1}{2}$, and carry 1 to the Pence, which are 56, which

is 4 *s.* 8 *d.* that is, 8 and I carry 4 to the Shillings; but as there are two Rows of Shillings, or *d uble Figures*, I first of all cast up that Row, or those Figures that stand towards the Right-hand, saying thus, 4 that I carry and 5 is 9, and 9 is 18, and 7 is 25, and 8 is 33, and 4 is 37, and 7 is 44 the first Row; then I come back upon the second Row, from the Top to the Bottom, calling every Figure of 1, Ten; saying, 44 and 10 is 54, and 10 is 64, (and so on) 74, 84, 94, and 10 is 104 Shillings, which is 5 *l.* and 4 Shillings over, that is 4, and I carry 5 to to the Pounds, which I find amount to 351. So that the Total is 351 *l.* 4 *s.* 8 *d.* $\frac{1}{2}$.

METHOD 2. Some like *this* Way best; they cast up the first Row of Shillings, as before, which comes to 44, that is 2 *l.* 4 *s.* and set the 4 Shillings under the said Row, and carry the 2 *l.* to the next Row of Shillings, counting 1 *l.* for every two Figures in the second Row, (because two Tens make 20 *s.* or 1 *l.*) Thus in the above Example, there are six Figures of 1 in the second Row, and counting two of them for 1 *l.* then six will be 3 *l.* which with the 2 *l.* that belonged to the 44 in the first Row, make 5 *l.* to be carried to the Pounds as before.

METHOD 3. Others make Use of *Dots*: That is, they make a Dot at every 4 in the Farthings, every 12 in the Pence, every 20 in the Shillings, and every 10 in the Pounds, which Method is very easy, and suitable to Lads of a dull Comprehension, and bad Memory; because they are not able to carry a large Number of Pence and Shillings in their Mind, but frequently carry false from Figure to Figure.

Note, There are different Opinions concerning Pointing, or Dotting: Mr. *Dilworth* highly recommends it; but Mr. *Fisher* calls it slovenly and unnecessary. It is not my Province to determine between these Gentlemen: But this I will say, that every Master should try all Methods, and let the Scholar use *that* which is most natural and easy to his Capacity. He must be very dull who can't tell that 2 Tens make 20, or that 3

Twenties

Twenties make 60: And to ſtop or point at ſo ſmall Numbers, as 3, 4, 5, 6, *&c.* ought (if poſſible) to be avoided; becauſe to add up well, and learn to caſt out quick, is a great Step towards *Multiplication*, and it would look very odd to ſee a Perſon (after having done a long Sum in that Rule) dot every Ten in caſting up the Product. I think therefore, there is no Occaſion to point or dot at every 4, 10, 12, or at even Twenties, when a little Practice will make it eaſy: But indeed when you come to do by 13, 16, 19, 28, or the like, there Dotting muſt unavoidably be uſed, as you will ſee in the firſt Example of *Averdupoiſe Weight*, wrought at large.

N. B. *If you are obliged to dot, mind and make them very ſmall; if you can ſee them yourſelf, that is ſufficient: But the firſt Method, in my Opinion, is beſt, except it be a very long Sum, ſuch as the Side of a large Book, a* Bill, *or a* Pariſh Rate, *or* Duplicate, *and then the following Method is the moſt certain and expeditious, and is very eaſy.*

METHOD 4. *Of making and caſting up long Bills,* PARISH RATES, *&c.*

Tyro. How is the general Way of caſting up very long Bills, Rates, *&c.*

Philo. The Rule is this: *For every* 60 *in the Pence carry* 5 *to the Shillings,* becauſe 60 Pence makes 5 Shillings: And *for every* 60 *in the Shillings carry* 3 *to the Pounds,* becauſe 60 Shillings make 3 Pounds; and *laſtly, caſt the Pounds up by Tens, as before directed.*

Tyro. Pleaſe to give me an Example at large.

Philo. I will ſhew you firſt, how to make a *Pariſh Rate,* which may be of Service, and if you can caſt it up well, you may alſo caſt up any long Bill, by the ſame Rule.

The Form of a PARISH RATE, *&c.*

	£.	s.	d.
Allen Anthony, *Esq*; ——	3	7	8 ¼
Andrews John —— ——	1	14	7 ½
Baker James, *Esq*; ——	15	16	8
Carter Thomas —— ——		17.	11 ½
Darby Abraham —— ——	5	17	5
Fernell Abraham —— ——		19	8 ¾
Honner Joseph —— ——	7		9.
Kirton John, *Esq*; ——	21	14.	7 ¼
Longman Thomas ——	5		11 ½
Lumley Edward —— ——	3	17	6
Manning Thomas —— ——		15	10 ¼
Martin William, *Esq*; ——	11	11	8 ½
Martin Job —— ——	7	17.	8
Nicholls Abraham —— ——	2	13	9
Norton Daniel, *Esq*; ——	17	10	4. ½
Parker Esther —— ——		8	11
Powell Judith —— ——		5	10
Randall Nicholas ——	1	17	6 ½
Robinson Abraham, *Esq*; ——	15	11.	11 ½
Robinson John ——	7	10	
Robinson James —— ——	1		10
Ruggles Nathaniel ——	7	11	4
Rumley Thomas ——		15	½
Solly Thomas, *Esq*; ——	12	11	
Sorsby William —— ——		14.	
Spratly David —— ——	8		11.
Swallow Thomas —— ——	1	17	4
Thompson John ——		19	11 ¾
Twist William, *Esq*; ——	7	7	
Walker John —— ——	1	15.	6
Wayland Edward, *Esq*; ——	8	14	9 ½
Wingate Samuel —— ——		15	7
Worley Abraham, *Esq*; ——	5	4	19
	£. 189	19	7 ¾

First,

First, I begin with the Row of Farthings (as in the former Questions) and find them amount to 27, which is 6 Pence, and 3 Farthings over; which 3 I set under the Farthings thus ($\frac{3}{4}$) and carry 6 to the Pence.

Secondly, For the PENCE.

I say 6 that I carry and 10 is 16, and 7 is 23, and 9 is 32, and 6 is 38, and 11 is 49, and 4 is 53, and 11 is 64; this being 4 above 60, I make a small Dot close to the 11, and carry the 4 that is over to the next Figure, saying 4 that I carry and 4 is 8, and 10 is 18, and 11 is 29, and 6 is 35, and 10 is 45, and 11 is 56, and 4 is just 60; therefore, as there is Nothing over to carry to the next Figure, I say 9 and 8 is 17, and 8 is 25, and 10 is 35, and 6 is 41, and 11 is 52, and 7 is 59, and 9 is 68; that is 8 above 60, therefore I make a Dot, and carry 8 to the next Figure, saying, 8 and 8 is 16, and 5 is 21, and 11 is 32, and 8 is 40, and 7 is 47, and 8 is 55: Now 50 Pence is 4*s.* 2*d.* therefore 55 Pence is 4*s.* 7*d.* which odd 7 Pence I set under the Pence, and carry the 4 Shillings to the Dots, counting (as I said before) 5 Shillings for every Dots, which are three in Number, that is, 15 Shillings; and the 4 I carried to them is 19 Shillings: This 19 I carry to the Shillings, and contrary to the other Methods, I now work Cross-ways, taking the *double Figures* as I go along; *viz* the Right hand Figure first, and then the Left-hand one belonging to it, counting it for 10, as follows.

Thirdly, For the SHILLINGS.

I say 19 that I carry and 4 is 23, and 5 is 28, and the 1 on the Left-hand of it, which is always counted for 10, is 38, and 4 is 42, and 10 on the Left-hand belonging to it is 52, and 5 is 57, and the 10 belonging is 67: Here, according to the same Rule, I make a Dot, and carry the odd 7 to the next Figure, as I did in the Pence; saying, 7 that I carry and 7 is 14, and 9 is 23, and

and 10 is 33, and 7 is 40, and 10 is 50, and 4 is 54, and 10 is 64; that is, Dot, and I carry 4, to 11 is 15, and 5 is 20, and 10 joining it is 30, and 11 is 41, and 10 is 51, and 11 is 62, which is Dot, and I carry 2 to the next Figure, proceeding in the ſame Manner, as before directed, till I come to the Top of all, and find there are 39 Shillings, beſides the laſt Dot, that is, 1 £. 19 *s.* therefore, I ſet the 19 under the Shillings, and carry the odd 1 £. to the Dots (counting 3 £. for every Dot, becauſe 60 Shillings is 3 £.) and find them 6, which is 18 £. and 1 I carried to them is 19 £. which I carry to the firſt Row of the Pounds, caſting them up by Tens, as in *whole Numbers*, and find them 189 £. So that the Total of the Rate, or Bill, is 189 £. 19 *s.* 7 *d.* $\frac{3}{4}$. Pray, *Tyro*, run it over once more, and the Method alſo, and you will not loſe your Labour.

Tyro. Sir, I ſee the Nature of it very well; but why do you leave thoſe Vacancies in the Shillings and Pence, for moſt people fill them up with Cyphers.

Philo. I know it is the common Cuſtom of Schools, but it is a very idle one, nor is it ſo ſightly or convenient; for the Cyphers hinder Sight, and prevent Expedition in caſting up. *See Example 6, in whole Numbers.*

5. *Of* CYPHERS, *where neceſſary, and where not.*

EXAMPLE 13, *without Cyphers, according to the true Order of* BOOK-KEEPING.

£.	s.	d.
5478 -	9 -	6
1 -	19 -	5
-	6 -	$8\frac{3}{4}$
179 -	-	
-	17 -	$\frac{1}{2}$
7 -	5 -	9
1 -	17 -	7
-	4 -	$\frac{1}{2}$
5670 -		$\frac{3}{4}$

EXAMPLE 13, *with Cyphers, according to the common Cuſtom of Schools.*

£.	s.	d.
5478 -	09 -	06
0001 -	19 -	05
0000 -	06 -	$08\frac{3}{4}$
0179 -	00 -	00
0000 -	17 -	$00\frac{1}{2}$
0007 -	05 -	09
0001 -	17 -	07
0000 -	04 -	$00\frac{1}{2}$
5670 -	00 -	$00\frac{3}{4}$

Now,

Now, *Tyro*, I would aſk you which is moſt ſightly, *that* which ſtands clear, or the other confuſed with Cyphers. And it is not only this, but every Line of the Sum, and the Total alſo, reads much better: For it is only five Thouſand, ſix Hundred, and twenty Pounds, and three Farthings; whereas the other, according to the Manner of Cyphers (and the too common Cuſtom of School-boys) muſt be thus read, *five Thouſand, ſix Hundred, and ſeventy Pounds, no Shillings, and no Pence, three Farthings*. And tho' Cuſtom ſome Years ago prevailed upon one of the moſt ingenious Authors*, to uſe the *Expreſſion* after this Sort; yet it does not at all juſtify the Correctors of the laſt Edition, ſince it is now quite ſuperfluous, and out of Date.

Note, Though I ſay it be not cuſtomary to uſe Cyphers, in *Addition of Money*, yet, in *Weights* and *Meaſures* they are often made Uſe of, and the Learner may take his own Fancy, that teaches himſelf; but it is my Opinion that Maſters in general would find it much eaſier and better, both to themſelves and Scholars, to ſet their *Addition* Sums quite clear, and uſe no Cyphers at all before Figures.

Tyro. I am obliged to you, Sir; and now, if you pleaſe, I would know how you prove *Addition?*

Philo. That is quite eaſy, *Tyro.*

6. *To prove* ADDITION *of* MONEY.

There are two Ways, one by cutting off the top Line (of which ſee under the Proof of *Addition*,) but it is not practicable in Buſineſs, the beſt Way is this: Begin at the Bottom and caſt up to the Top, noting down what it comes to; then begin at the Top, and caſt the ſame Row downwards, and if it amounts to the ſame as before, there is no Doubt but the Work is right, provided you obſerve carefully to ſet it down right.

* *Wingate*, Page 8.

SECTION V.

Containing some farther Explanation of Things necessary to be known, with the Manner of drawing out Bills, *writing* Notes, *and* Receipts, &c. *being very proper to exercise the young Beginner.*

Tyro. I shall be at a Loss under this Section.

Philo. You are mistaken; for I shall not leave you to yourself wholly, but will explain every Thing I am capable of, to your Understanding; because I am sensible many School-boys can add up Sums that are set them very well; but when they are called upon out of School, to write out, and cast up a small Bill, or the like, how awkward do they go about it, and will set puzzling over it so long, that one would think they knew Nothing at all of the Matter: And when it is done, it is often set in such Confusion, that it will puzzle much better Scholars than themselves to cast it up; because they do not observe to place their Figures right under one another, which besure, *Tyro*, you be always careful of for it is a great Advantage, and the Work will look neat, and you will have the Praise.

Tyro. 'Tis very true, Sir, I have known several that could cast up a Bill if others would figure it down, but have not had any Notion of drawing it out themselves: Nor can I say I have, and therefore should be obliged to you to shew me.

Philo. That I will; but first of all, it will be proper to shew you some *Contractions* made Use of both in Books and Bills.

1. *Of contracted Words, and what they signify.*

Note, 1. *Bt.* stands for, or signifies *Bought.*

2. *Dr.* is *Debtor.* *Cr.* is *Creditor.*

3. *Do.* stands for *Ditto*, and signifies the same Thing, Place, or Sort of Goods, as was wrote in the Line before;

fore; it is uſed by Merchants, Tradeſmen, and Accomptants, both in Books and Bills, to avoid writing the ſame Thing over and over again.

4 *Co.* ſignifies *Company*; that is, when two or more are in Trade and in Partnerſhip.

5. *Meſſrs.* ſignifies *Meſſieurs*, or Gentlemen concerned together in ſome Trade or Buſineſs, and is uſed with the foregoing Contraction, (*Co.*) on the Head or Front of the Bills, inſtead of writing all their Names at Length: Thus, Suppoſe *John Sharp* to have a Bill upon *Aaron Nelſon, John Long*, and *Joſeph Truman*, it would be ridiculous to write thus:

Mr. *Aaron Nelſon*, Mr. *John Long*, and Mr. *Joſeph Truman*, bought of *John Sharp*. —— But we write thus:

Meſſrs. *Aaron Nelſon* and *Co.* Bt. of *John Sharp*, as you will ſee in the following Example.

A Linnen Draper's BILL.

EXAMPLE I.

Meſſrs *Aaron Nelſon* and *Co.* Bt. of *John Sharp*.

			£.	s.	d.
1753					
4	*Jan.*	11 Pieces of *Iriſh*, at 3*l.* *per* Piece —— ——	33 –	–	
12		2 Ditto at Do ——	6 –		
8	*Feb.*	Long Lawn, as by Agreement.	3 –	15 –	6
12	*Apr.*	2 Pieces of Check, as by Do.	1 –	7 –	10
28		4 Do as by D. ——	2 –	2 –	
24	*May*	2 Yards of Dowlas, at 11 *d.*	–	1 –	10
9	*Aug.*	A Parcel, as *per* Bill ——	1 –	15 –	6
		This Bill I caſt up as a common Sum in *Addition of Money*, and find the Total	48 –	2 –	8

Ex-

EXAMPLE 2.

A Stationer's BILL.

Mr. *Samuel Long* Bt. of *John Page.*

1753			£.	s.	d.
May	19	2 Ream of Fool's Cap superfine Paper	1	10	–
June	12	4 Ditto	3	–	
		20 Ream of coarse Brown	1	10	6
Aug.	14	Sundry Goods, as *per* Bill	3	19	6
			£. 10	–	–

Note, Some Persons never use the Word *To* at the Beginning of the Bill. *Note* farther, the Word *To* is used in Books of Accompts on the *Dr.* or Left-hand Side. The Word *By* is used on the *Cr.* or Right-hand Side.

And now, *Tyro,* I shall draw you out a few more Bills, and leave you to set them on a Slate, and cast them up yourself, which will be of Service, by Way of Exercise.

EXAMPLL 3.

A Goldsmith's BILL.

Mr. *James Proud* Bt. of *Paul Fineshew.*

1753			£.	s.	d.
May	9	1 Diamond Ring	15	–	–
		2 Pair of Silver Salts	2	2	6
		1 Quart Tankard	10	10	–
		1 Pint Do.	4	7	6
		1 Dozen of Knives and Forks	3	2	6
		1 Silver Tea-Kettle	5	5	–
		12 Tea-Spoons, Tongs, and Cream-pot	1	15	–
		Total £.			

Ex.

EXAMPLE 4.

A Taylor's BILL.

Mr. *Robert Patience* Dr. to *John Trimmer.*

		£.	s.	d.
1753				
Mar. 15.	2 Yards of Cloth, at 18 *s. per* Yard	1	16	–
	Making your Coat ———	–	8	–
	4 Yards and a half of Shalloon, at 2*s.*	–	9	–
	Buckram, Staytape, and Canvas –	–	3	6
	Silk, Twist, and Mohair ———	–	2	8
	Making a Suit for your Son ———	–	15	9
	Buckram, Silk, Twist, Mohair, &c.	–	4	3
	Buttons to the same ———	–	3	6
		£.		

Now, from these four Examples, *Tyro,* you may form any other Tradesman's Bill in due Order; and as for making out or balancing any Reckoning, between one Person and another, to see how much is due to either, is not the Work of *Addition*; but I shall explain it very fully to you in *Subtraction.*

2. *The Manner, or common Form of* Receipts, *and* Notes of Hand.

Tyro. How am I to give, or write a *Receipt?*

Philo. According to what Money you receive, and the Persons you receive it of, or for. Let us take the Stationer's Bill in *Example* 2, which is 10*l.* Now, if he receives it in full, the Receipt will run thus:

August 6, 1753. *Received of Mr.* Samuel Long *Ten Pounds, in full of all Demands.*

John Page.

£. 10.

If

If the Receipt be wrote upon the Bill itſelf, then this is better:

Received at the ſame Time the Contents in full.

John Page.

EXAMPLE 2. If only Part be received, then thus:

Auguſt 16, 1753. *Received of Mr.* Samuel Long *Five Pounds, on Accompt.*

John Page.

£. 5.

EXAMPLE 3. If the Perſon that receives the Money be a Son or Servant, he muſt write thus:

Auguſt 16, 1753. *Received of Mr.* Samuel Long *Ten Pounds in full, for my Father (or Maſter.)*

John Page, *jun.*

EXAMPLE 4. For Rent.

June 14, 1753. *Received of Mr.* John Lumley *twelve Pounds, ten Shillings, for Half a Year's Rent, due at* Lady-Day *laſt.*

Abraham Gripe.

£. 12 – 10

EXAMPLE 5. When there has been an Account of long ſtanding, and at laſt the two Parties agree to have a Reckoning, but ſtill he that owes Money upon the Balance has none at that Time to pay, then the following Form is counted better than a common Note of Hand, becauſe it ſhews the Reaſon of ſuch an Acknowledgment: But then this Writing ſhould be drawn in the Book of the Perſon to whom the Balance is due, and if ſigned in the Preſence of Witneſſes the better. The Form is thus:

Auguſt

August 16, 1753 *Reckoned and balanced all Accompts, and I* Samuel Long *acknowledge myself to be indebted to* John Page *three Pounds, ten Shillings, which I promise to pay on Demand, for Value received. Witness my Hand,*

Test. Samuel Long.
Abraham Justice.

EXAMPLE 6. When a Person has no Money about him, or has his Money in other Persons Hands, and gives you a Note or Draught upon them for the Payment of any Sum, it is wrote after this Manner:

Sir, Please to pay to Mr. John Page, *or Bearer, three Pounds, ten Shillings, and place it to the Accompt of*
Your humble Servant,
To Mr. Jonathan Trusty. Samuel Long.

3. *Of the Value of the common Coins used in* England, *how they are expressed, and how set down.*

A *Port*, or *Portugal* Piece, is set down 1 *l.* 16 *s.* but is expressed, or commonly called, a Six and Thirty.
A double *Port* is 3 *l.* 12 *s.*
A *Moidore* is set down 1 *l.* 7 *s.* but called a Seven and Twenty.
A *Guinea* is 1 *l.* 1 *s.* and expressed a Guinea.
A *Crown* is expressed a Crown; but set down 5 *s.*
Half a Crown is 2 *s.* 6 *d.*
A *Tester* is Six-pence.
A *Groat* is Four-pence.

An useful EXAMPLE.

A Servant laid out Cash as follows: For *Coals* a Guinea and a Half. *Cloth* Three and Twenty and Six-pence. *Meat* seven Groats. *Butter, Eggs,* and *Bacon* Nineteen-pence Halfpenny, and *Thread* seven Farthings. What was laid out in all?

Tyro. I set them down as follows.

	£.	s.	d.
For Coals ——— ———	1	11	6
Cloth ——— ———	1	3	6
Meat ——— ———		2	4
Butter, Eggs, and Bacon		1	$7\frac{1}{2}$
Thread ——— ———			$1\frac{3}{4}$
In all	2	19	$1\frac{1}{4}$

Philo. Very well done indeed. *Observe further then,* that from *one* to *two* Shillings, and from *one* to *two* Pounds, the *Expression* is different from the *Setting-down.* Thus, 1 *s.* 10 *d.* $\frac{1}{2}$ is expressed Two and Twenty-pence Halfpenny; and 1 *l.* 19 *s.* 6 *d.* is expressed Nine and Thirty and Six-pence.

So also, though these Numbers, 1300, 1754, and 2500, are properly, one Thousand three Hundred, one Thousand, seven Hundred, and Fifty-four, and two Thousand, five Hundred; yet they are thus expressed; thirteen Hundred, seventeen Hundred and Fifty-tfour and Five and Twenty Hundred.

Tyro. I heartily thank you, kind Sir, and if it were not too troublesome, I could wish you would set me a few Questions by Way of Exercise.

Philo. You do very well to ask me, *Tyro*; but it will be better at the End of *Addition,* where I shall give you some useful Examples.

SECTION VI.

AVERDUPOIS WEIGHT.

Tyro. PRAY what is the Use of this Rule, or what is weighed by it?

Philo. Most Things that are commonly dealt in, such as *Grocery-Wares,* and also, *Cheese, Butter, Soap, Candles,*

Candles, *Allom*, *Brafs*, *Iron*, *Copper*, *Salt*, *Hemp*, and all ſuch Sort of Goods.

Tyro. What are the different Names or Denominations of the Weights uſed in this Rule.

Philo. The *greateſt* Denomination is a *Ton*, and the *leaſt* a *Dram*. They run thus in Order, *Tons*, *Hundreds*, *Quarters*, *Pounds*, *Ounces*, and *Drams*; of which is compoſed the following Table, with the Characters that ſtand for each Denomination after them.

The TABLE.

16 Drams	make	1 Ounce, marked thus,	*oz.*
16 Ounces	make	1 Pound	*lb.*
28 Pounds	make	1 Quarter of an Hundred	*qr.*
4 Quarters	make	1 Hundred Weight	*Ct.*
20 Hundreds	make	1 Ton	*T.*

Tyro. Should I get this Table by Heart?

Philo. You may do as you pleaſe: I know ſome Maſters call it unneceſſary; but if you take my Advice, learn every Table perfectly. 'Tis true, you may do the Sums without it, if you have the Table before you, but it would be a very bad Thing to make an Excuſe, by ſaying, you could do ſuch a Sum if you knew the Rule by Heart; and I have known many a Lad lament the Omiſſion.

Tyro. I don't doubt it at all, and I will take your Advice: Pleaſe to tell me how you caſt up thoſe Sums.

Philo. The ſame as in *Addition of Money*, only you ſtop (as is plain by your Table) by different Figures; and for your further Information, I ſhall put over every Row and Denomination, the Quantity you are to ſtop at, or do by, and ſhall give you one Example at large as a ſtanding Rule for all that follows.

EXAMPLE 1.

(10)	(20)	(4)	(28)
Tons	*C.*	*qrs.*	*lb.*
25 –	14 –	1 –	15.
18 –	11 –	2 –	16
27 –	17 –	3 –	21.
46 –	14 –	1 –	17.
16 –	17 –	2 –	15
45 –	15 –	1 –	17.
16 –	17 –	3 –	14
198 –	9 –	1 –	3

EXAMPLE 2.

(10)	(4)	(28)	(16)
C.	*qrs.*	*lb.*	*oz.*
42 –	1 –	17 –	10
17 –	2 –	19 –	14
21 –	3 –	22 –	11
17 –	2 –	17 –	12
24 –	1 –	22 –	15
65 –	3 –	17 –	13
24 –	1 –	21 –	10

I begin at the *lbs.* and ſay, 14 and 7 is 21, and the 1 on the Left-hand (which is always called 10) is 31; that is, 3 above 28; therefore, I make a Dot againſt the 7, and carry the odd 3 forward; ſaying, 3 that I carry and 5 is 8, and 10 on the Left of it is 18, and 7 is 25, and 10 on the Left is 35, that is, 7 above 28; then I dot again, and carry 7 to the next Figure, ſaying, 7 and 1 is 8, and the 2 on the Left-hand which ſtands for 20, is 28; therefore, as there is nothing over, I only ſay 16 and 5 is 21, and 10 is 31, that is, 3 above 28, which 3 I place under the Row of Pounds, and then telling my Dots, I find them 4 (that is 4 qrs.) which I carry to the next Row of qrs. ſaying, 4 and 3 is 7, and 1 is 8, and 2 is 10, and 1 is 11, and 3 is 14, and 2 is 16, and 1 is 17 Quarters. Now as 4 Quarters make an Hundred, I aſk how many *Fours* I can have in 17, and find 4 *Fours*, and 1 over, that is, 4 Hundred, 1 Quarter, which 1 I place under the Row of Quarters, and carry the 4 to the Hundreds, which I caſt up by *Twenty*, the ſame as in *Addition of Money*, ſaying, 4 that I carry and 7 is 11, and 5 is 16, and 7 is 23, and 4 is 27, and 7 is 34, and 1 is 35, and 4 is 39; then I come back with the Tens, ſaying, 39 and 10 is 49, and 10 is 59, and ſo on, 69, 79, 89, 99, and 10 is 109, which is 5 Twenties, and

9

9 over; that is, 5 Tons, and 9 Hundred over, which 9 I place under the Hundreds, and carry 5 to the first Row of the Tons, and casting them up as Whole Numbers by Tens, I find the first Row 48. that is, 8 and I carry 4 to the next Row, which amounts to 19. Therefore the Total is 198 *Tons*, 9 *C*. 1 *qr*. 3 *lb*.

☞ This is a standing Rule, *Tyro*, of all your other Sums in *Addition*, which are cast up after the very same Manner: Those that you find done are for your Information and Satisfaction; and such as are left undone are for your Practice. Are you satisfied with what I have told you?

Tyro. Sir, I am; but in *Example* 2, I perceive you set 10 over the *Hundreds* Place, contrary to the Table; whereas in *Example* 1, you have set 20 over the *Hundreds* Place, which I own puzzles me at present.

Philo. That is for Want of a little Consideration, *Tyro*: For whatever *Name* or *Denomination* stands first (that is, whatever you add up last) is always added up like *Whole Numbers*, by *Tens*; be they *Tons*, *Hundreds*, *Pounds*, *Shillings*, *Yards*, *Ells*, or any Thing else, as you will see hereafter.

Tyro. I am obliged to you Sir, and desire no further Instruction in *Addition*, but only the Rules and Examples to go by.

Philo. You shall not want for either, and they are all done after the same Manner as this Example before you, though by different Figures: And pray take *Notice*, all those Examples that you find ready done, are not to indulge you in Idleness; but the Answers are inserted for your Information and Satisfaction; and those that are left undone are for your Exercise, Practice, and Improvement; and though I told you in *Addition of Money* it is not customary to use Cyphers; yet, if you chuse it, take your own Way; but you will find it better to leave them out, when there is no Occasion to use them.

AVOIRDUPOIS *Small Weight*.

Tyro. What is the Uſe of this Rule?

Philo. It is chiefly uſed by ſuch as deal in Silk, Worſted, Thread, *&c.* by *Retail*, or in ſmall Quantities only; that is, from a Dram to Pounds, 16 Drams make an Ounce, and 16 Ounces 1 Pound.

EXAMPLE 1.			EXAMPLE 2.		
(10)	(16)	(16)	(10)	(16)	(4)
lb.	*oz.*	*d.*	*lb.*	*oz.*	*qrs.*
2 –	10. –	5.	3 –	14 –	2
4 –	7 –	3	1 –	11 –	1
1 –	6 –	11	3 –	9 –	0
6 –	9 –	0	2 –	01 –	2
3 –	7 –	9	1 –	00 –	3
18 –	8 –	12			

Note, *Worſted* is weighed by Ounces and Quarters, as in *Example* 2, and no Drams are uſed here, nor in retailing many other Commodities.

Of WOOL.

Wool is weighed by the *Clove*, *Stone*, *Tod*, *Wey*, &c. as follows:

7 Pounds make 1 Clove
2 Cloves, or 14 *lb.* 1 Stone
2 Stone, or 28 *lb.* 1 Tod
6½ Tod 1 Wey
2 Weys 1 Sack
12 Sacks 1 Laſt.

Note, In ſome Places 7 Tod are allowed to 1 Wey, and 12 Score, or 240 *l.* is called a *Pack of Wool*.

Note

Note farther.

A *Firkin* of Soap is 64 *lb.*
A *Firkin* of Butter 56 *lb.*
A *Clove* of Cheeſe 8 *lb.*
A *Wey* of Cheeſe in *Eſſex* is 32 Cloves, or 256 *lb.*
A *Wey* in ſome Parts of *Suffolk* is the ſame; but in other Parts of it, 42 Cloves, or 336 *lb.* make a Wey.

☞ *See* another Table of *Weights* and *Meaſures*, *Section* 6.

TROY-WEIGHT.

Tyro. Of what Uſe is *Troy-Weight?*

Philo. By this is weighed Gold, Silver, Jewels, Electuaries, *&c.* and Liquors in general.

TABLE.

Note,	24 Grains.	make	1 Penny-wt.	*dw.*	thus.
	20 Penny-wts.		1 Ounce.	*oz.*	
	12 Ounces.		1 *lb.* *Troy.*	*lb.*	

Note 1. You need not *point* or *dot* at any Row except the firſt, where you do by 24; the others are eaſy and common, as before, the Penny-weights being caſt up by 20, are done the ſame as Shillings; and the Ounces being done by 12, are caſt up like Pence, in *Addition of Money.*

(10) *lb.*	(12) *oz.*	(20) *dw.*	(24) *gr.*	(10) *lb.*	(12) *oz.*	(20) *dw.*	(24) *gr.*
42	11	14	18.	647	11	17	16
26	9	10	21	196	10	15	23
49	10	11	11.	494	11	19	14
65	8	14	12	165	9	15	21
73	9	15	16.	219	1	11	19
87	11	18	11	648	8	15	21
347	2	5	17				

Note 2. That 1 *lb. Averdupois-Weight* is equal to about 14 Ounces 12 Penny-weights *Troy*.

Note 3. Custom only introduced *Avoirdupois-Weight* and *Beer-Measure*: For, according to the Statute Laws, there should be but one *Weight* and one *Measure* throughout the whole Realm, as you may see under *Dry-Measure*, *Note* 1. Therefore, it is evident, that from these two different Weights, came the different Sorts of Measures, as you will more plainly see under *Dry-Measure* and *Liquid-Measure*.

Note farther the Value of Gold *and* Silver.

Gold.	£.	*s.*	*d.*
That 1 Pound Weight of Gold is worth	48	0	0
1 Ounce	4	0	0
1 Penny-weight	0	4	0
1 Grain	0	0	2

Silver.	£.	*s.*	*d.*
That 1 Pound Weight of Silver is worth	3	0	0
1 Ounce	0	5	0
1 Penny-weight	0	0	3
1 Grain about $\frac{1}{2}$ a Farthing.			

APOTHECARIES WEIGHT.

Tyro. What is the Use of this Weight?

Philo. By it *Apothecaries* mix and compound their Medicines, their Pound being the same as the Pound *Troy*, only

only differently divided, as you ſee in the following *Table.*

Note, **Though *Apothecaries* mix their Medicines by this Rule, they buy and ſell their Drugs by *Averdupois-Weight.***

The TABLE.

20 Grains	make	1 Scruple	℈ thus marked.
3 Scruples		1 Dram	ʒ
8 Drams		1 Ounce	℥
12 Ounces		1 Pound	℔

(10)	(12)	(8)	(3)	(20)		(10)	(3)	(20)
℔	℥	ʒ	℈	*gr.*		ʒ	℈	*gr.*
42	10	7	2	19		18	1	14
17	8	5	2	11		12	2	17
43	7	6	1	10		41	1	10
15	4	5	1	9		24	2	15
40	11	3	1	8		16	1	11
64	9	6	2	15		17	2	15
232	5	4	0	12				

DRY-MEASURE.

Tyro. What is the Uſe of *Dry Meaſure?*

Philo. By this Rule is meaſured all dry Goods, ſuch as Coals, Sand, Salt, Fruit, Oyſters, Wheat, Barley, Peas, and other Grain, as appears by the two following Tables.

TABLE 1.

2 Pints	make	1 Quart
2 Quarts		1 Potttle
2 Pottles, or 8 Pints		1 Gallon
2 Gallons, or 16 Pints		1 Peck
4 Pecks		1 Buſhel
4 Buſhels		1 Coomb
2 Coombs, or 8 Buſhels		1 Seam, or Quarter
5 Quarts, or 40 Buſhels		1 Load.

TABLE 2. *For Coals.*

4 Pecks	make	1 Bushel
9 Bushels		1 Quarter of a Chaldron
4 Quarters, or 36 Bushels		1 Chaldron
Note, 5 Pecks		1 Bushel, Water-Measure

Note 1. That 33 *Cubic* Inches, and 3 Fifths, make a *Corn* Pint, 268 Inches, and 4 Fifths, a *Corn* Gallon, and 2150 Inches, 2 Fifths, a true *Winchester* Bushel, according to the Act of Parliament, made in 1697, which says, That every round Bushel with an even Bottom, that is, 18 Inches wide, and 8 Inches deep, shall be deemed a true legal *Winchester Bushel*.

(10) *Loads*	(5) *qrs.*	(8) *B.*	(4) *Pecks*
24	4	7	3
19	3	5	2
49	2	3	1
47	3	1	2
56	1	5	3
17	3	4	2
215	4	4	1

(10) *Chal.*	(4) *qrs.*	(9) *Bush.*
64	2	8
17	1	6
48	2	3
17	1	4
96	2	5
17	3	7

(10) *Chal.*	(36) *B.*	(4) *Pecks*
47	31	2
19	17	1
47	16	2
56	14	1
17	13	2
47	27	3

Note 2. The common received Contents of a *Corn* Gallon is 272 Inches. For *Dry-Measure* is a Mean, as it were, between *Wine* and *Beer-Measure*. For as 12 *oz.* *Troy* is to 224 Inches; so is 14 $\frac{12}{20}$ oz. to 272 Inches nearly. *See Note* 3, in *Wine Measure*.

Note 3. That *Salt*, *Sea-Coal*, and many other Commodities, are heaped in the Measuring in general; and where they are not, it is customary to allow 5 struck Pecks to the Bushel. *Bran* is double Measure; that is, 2 Pecks struck are allowed for one Peck.

Ob-

Observe farther.

A Score of Coals —— ——	is 21 Chaldron, that is, those that buy 20 Chaldron have 21 for 20
A Sack of Coals ——	3 Bushels
A Sack of Corn in common —	4 Bushels
A Sack of Flour —— ——	5 Bushels
A Load, called a Market Load	5 Bushels
A Load in general means —	40 Bushels
A Wey is 10 Quarters, or 2 Loads	80 Bushels
A Last in some Places is 12 Wey, *viz.*	960 Bushels

See *Section* 6, in *Addition.*

LIQUID-MEASURE.

Tyro. What is the Use of this *Measure?*

Philo. All Sorts of Wine, spirituous Liquors, and Beer and Ale are measured by it, under the Names of *Wine-Measure*, and *Winchester-Measure.*

1. *Of* WINE-MEASURE.

TABLE.

2 Pints	make	1 Quart
4 Quarts	make	1 Gallon
10 Gallons	make	1 Anchor of Brandy, or Rum
18 Gallons	make	1 Runlet
31 ½ Gallons	make	1 Barrel of Wine or Vinegar
42 Gallons	make	1 Tierce
63 Gallons	make	1 Hogshead
2 Hhds. or 126 Gallons	make	1 Butt, or Pipe
2 Pipes, or 252 Gallons	make	1 Tun

Note 1. A *Puncheon* is 1 Anchors, or 80 Gallons; but any Cask between a *Hogshead* and a *Pipe*, is called a *Puncheon.*

(10) Tuns	(2) Pipes	(2) Hhds.	(63) Gall.
47	1	1	21.
49	0	1	57
64	1	0	16.
45	1	1	18
27	0	0	15
56	1	1	17
291	1	0	18

(10) Hhds.	(36) Gall.	(8) Pints
47	19	7
26	14	1
94	17	5
57	47	6
19	14	4
45	49	5

Note 2. *Cyder, Perry, Oil, Vinegar, &c.* are bought and ſold by this Meaſure; and Milk is alſo ſold in the City of *London* by it; there being no Standard to the contrary, corrupt Cuſtom has reduced the largeſt of liquid Pints to one Half its proper Quantity.

Note 3. The *Wine-Pint* (according to Cuſtom) is reckoned to contain 28 *Cubic* Inches and 7 Eighths; and the *Gallon* 231 Inches. But by an Experiment made at *Guild-Hall*, in *London*, (1688) a Veſſel containing but 224 *Cubic* Inches, was filled with Water, and careſully emptied into the *Wine Gallon* kept there, which did exactly fill it. But notwithſtanding *this*, it was thought proper to continue 231 Inches to the Gallon, which remains to this Day. And from this Increaſe of the *Wine Gallon* (anſwering to *Troy Weight*) came the Increaſe of the *Beer Gallon*, which anſwers to *Avoirdupois Weight*. See *Note* 1, in *Wincheſter-Meaſure*.

2. WINCHESTER-MEASURE.

Tyro. What are the different Meaſures and Denominations for *Beer* and *Ale?*

Philo. They are as under.

TABLE.

2 Pints	make	1 Quart
4 Quarts	make	1 Gallon
9 Gallons	make	1 Firkin
2 Firkins, or 18 Gallons	make	1 Kilderkin
2 Kilderkins, or 36 Gallons	make	1 Barrel
1 ½ Barrel, or 54 Gallons	make	1 Hogſhead
2 Hhds, or 3 Bar. or 108 Gall.	make	1 Butt
2 Butts, or 216 Gallons	make	1 Tun

Note

Note 1. That 35 *Cubic* Inches 1 Quarter make a *Beer* Pint, and 282 (nearly) 1 Gallon, which anſwers to *Avoirdupois-Weight.* For as 12, the Ounces in 1 *lb. Troy,* is 231, the Inches in a *Wine* Gallon; ſo is $14\frac{12}{20}$ Ounces to 282, the Inches in a cuſtomary *Bear* Gallon. See *Note* 2, *Troy-Weight.*

(110) *Butts*	(2) *Hhds.*	($1\frac{1}{2}$) *Bar.*	(2) *Kild.*	(2) *Firk.*	(9) *Gall.*
15	1	0	1	1	5
23	0	1	0	1	2
41	1	1	1	1	3
22	1	0	1	0	2
7	1	1	0	1	5
1	0	1	1	0	4
113	0	1	1	0	3

(10) *Butts*	(3) *Bar.*	(36) *Gall.*
64	1	27
15	2	18
21	1	14
25	0	15
62	1	16
5	0	29

Note 2. That in gauging *Beer* and *Ale* in *London,* 32 Gallons is a Barrel of *Ale,* and 36 a Barrel of *Beer*; but in other Places 34 Gallons is a Barrel, one with another, and *Common Brewers* in the Country allow Victuallers 36 *Gallons* of both Sorts to the Barrel.

CLOTH-MEASURE.

Tyro. What are the *Denominations* of this Meaſure?

Philo. Yards, Quarters, and *Nails:* Alſo, *Ells Engliſh, Ells Flemiſh,* and *French Ells,* as appears by the Table.

TABLE.

2 Inches and a Quarter	make	1 Nail
4 Nails	make	1 Quarter of a Yard
4 Quarters	make	1 Yard
3 Quarters of a Yard	make	1 Ell *Flemiſh Meaſure*
5 Quarters, or 1 Yd. 1 qr.	make	1 Ell *Engliſh*
6 Quarters	make	1 *French* Ell

Note 1. That Things in common, ſuch as *Woollen, Linen, Silk, Tape, Cord,* &c. are meaſured by the Yard: But *Hollands* are in general meaſured by the Ell *Engliſh,* and *Tapeſtry* by the Ell *Flemiſh.*

Note

***Note* 2.** **That 16 Nails make a Yard, 20 Nails an Ell *English*, and 12 Nails an Ell *Flemish*.**

(10) *Yds.*	(4) *qrs.*	(4) *Nails*	(10) *Ells Eng.*	(5) *qrs.*	(4) *N.*	(10) *Ells Fl.*	(3) *qrs.*	(4) *N.*
47	3	2	64	4	3	17	2	3
19	2	1	17	2	1	41	1	2
16	3	2	19	3	2	19	2	1
14	1	1	15	4	3	64	1	2
17	1	2	16	2	1	14	2	1
21	2	1	17	2	3	25	1	3
137	2	1						

LONG-MEASURE.

Tyro. What does *Long-Measure* teach ?

Philo. To know the Length or Breadth of any Thing, and the Distance of one Thing, or Place, from another, as by the following Table.

TABLE.

3 Barley Corns	make	1 Inch
12 Inches		1 Foot
3 Feet		1 Yard
2 Yards, or 6 Feet		1 Fathom
$5\frac{1}{2}$ Yards		1 Rod, Pole, or Perch
40 Rods		1 Furlong
8 Furlongs		1 Mile
3 Miles		1 League
20 Leagues, or 60 Miles		1 Degree
360 Degrees		The Circumference of the Earth and Sea.

***Note* 1.** **An Hand, or Hand's Breadth in Horsemanship is 4 Inches.**
A common Pace is 2 Feet 6 Inches.
A geometrical Pace is 5 Feet.

(10) Deg.	(20 Leag.	(3) Miles	(8) Fur.	(40) Rods
25	19	2	7	21
17	14	1	5	19
16	8	2	2	15
21	5	1	4	27
47	7	2	1	14
15	10	1	5	37
144	7	0	3	13

(10) Rods	($5\frac{1}{2}$) Yds.	(3) Feet	(12) Inches
42	4	1	11
61	3	0	10
17	1	1	9
24	0	2	8
16	2	1	7
72	1	0	6

Note 2. According to the Table 60 Miles make one Degree, therefore the Earth is 21600 Miles round: But 69 $\frac{1}{2}$ Miles (very nearly) make but one Degree, and therefore the Circumference of the Earth is about 25000 Miles; as you will see in *Reduction*.

LAND-MEASURE.

Tyro. What are the Denominations of *Land-Measure?*

Philo. Almost the same as in *Long-Measure*; but as they never regard the Inches and Barley Corns, this Table is sufficient.

TABLE.

$5\frac{1}{2}$ Yards, or 16 Feet $\frac{1}{2}$	make	1 Rod, Pole or Perch
40 Rods, or Poles	make	1 Furlong in Length
40 Rods in Length, and 1 in Breadth	make	1 Rood, or Quarter of an Acre
4 Roods, or Quarters	make	1 Acre

Note 1. That though 16 $\frac{1}{2}$ Feet make a Statute, Pole, or Rod, yet it is customary in some low, fenny Countries, and barren Lands, to allow 18 Feet, and in measuring Forest 21 Feet to the Pole.

(10) Acres	(4) Roods	(40) Poles	($5\frac{1}{2}$) Yds.
7	1	14.	1
9	3	27	2
4	1	29.	3
15	2	27	4
37	1	18	$4\frac{1}{2}$

(10) Acres	(4) Roods	(40) Poles
15	1	19
26	2	24
19	3	27
47	1	15

Note

Note 2. The common Inſtrument uſed in meaſuring Land is an Iron Chain, containing 100 Links, which is 4 Rods, or 22 Yards in Length; therefore, 10 Chains in Length, and 1 in Breadth, make an Acre, and 80 Chains in Length only make a Mile, or 1760 Yards.

SQUARE-MEASURE.

Tyro. What do you mean by *Square-Meaſure?*

Philo. You are not to expect, *Tyro*, as yet, to know the Nature of it; it is ſufficient at preſent, that you only know this, that *Long-Meaſure* ſhews you only the Length or Breadth of any Thing; but *Square-Meaſure* tells you the Contents of any Thing, which you can have no Notion of till you have learnt *Diviſion*; but it will not be amiſs to learn the following Table by Heart (at your Leiſure) that you may be the better able to underſtand it by and by.

16	Square Quarters	make	1 Square Inch
144	Square Inches	make	1 Square Foot
9	Square Feet	make	1 Square Yard
30	Square Yds. 1 Qr. or 272 Square Feet 1 Quarter	make	1 Square Rod, or Pole
160	Square Rods	make	1 Acre of Ground

Note, One Example with Yards and Feet only will be ſufficient at preſent.

(10) *Yards*	(9) *Feet*
45 –	6
29 –	3
47 –	8
25 –	5

Of TIME.

Tyro. What is *Time*, and how is it divided?

Philo.

Philo. Time ſhews us the Beginning, Mutation, (or Changing,) Continuation, and Ending of all mutable Things. It is meaſured by *Years*, *Months*, *Days*, *Hours*, *Minutes*, and *Seconds*, and divided as follows, which will ſerve all common Purpoſes.

TABLE.

60″	Seconds	make	1 Minute of Time
60′	Minutes	make	1 Hour
24	Hours	make	1 Natural, or real Day
7	Days	make	1 Week
4	Weeks	make	1 Month
13	Months or	make	1 Year
365	Days	make	1 Year

Note 1. Though the Table ſays 13 Months, or 365 Days, make a Year, yet it is not truly ſo; for 13 Months (allowing 4 Weeks to the Month) is but 364 Days: Whereas 13 Months, 1 Day, 6 Hours make a Year; for theſe odd Hours make 24 Hours, or 1 Day, every fourth Year, which is added to *February*, which has then 29 Days, and is called *Leap-Year*: But a true Year is 365 Days, 5 Hours, 48 Minutes, and is called a *Solar Year*, being the Time that the Sun performs its apparent Revolution through the *Ecliptic*; but you muſt not buſy yourſelf, and loſe your Time about theſe Things, which are too hard for you to underſtand at preſent.

Note 2. Though 13 Months are ſaid to make a Year, and Servants commonly reckon a Month 28 Days: yet you are to obſerve, that in Trade, and tranſacting Buſineſs, by a Month is meant a *Calendar Month*, that is, from any Day of the Month to the ſame Day of the next Month: Thus, from the 5th of *February* to the 5th of *March*, or from the 18th of *April* to the 18th of *May*, is a Month.

Ex-

EXAMPLE 1.				**EXAMPLE 2.**			
(10)	(13)	4	(7)	(10)	(24)	(60)	(60)
Years	*Months*	*Weeks*	*Days*	*Days*	*Hours*	*Min.*	*Sec.*
27 –	11 –	3 –	6	41 –	22 –	50 –	27
43 –	9 –	2 –	5	17 –	17 –	17 –	15
27 –	5 –	1 –	4	24 –	15 –	27 –	14
36 –	1 –	2 –	3	19 –	21 –	19 –	24
45 –	10 –	2 –	1	27 –	11 –	18 –	19
28 –	12 –	1 –	4	35 –	14 –	25 –	25
209 –	12 –	2 –	2				

Note 3. In *Example* 2, you muſt point or dot at every Row but the laſt.

And now, *Tyro*, I think you may by this Time be perfect in *Addition*, I ſhall only ſet you a few Queſtions, and proceed to *Subtraction*.

SECTION VI.

Containing ſome other uſeful Things, neceſſary to be known in Number, Weight, *and* Meaſure.

Note 1. *Of Things bought and ſold by the* Dozen, Score, *or* Groſs.

A *Dozen* is 12. A *Score* is 20. A *common Hundred* is 100. A *long Hundred* is 120. A *Groſs* is 12 Dozen, or 144, and a *Great Groſs* is 12 Times as many, or 1728. *Oranges*, and *Lemons*, *Corks*, *Bungs*, and many other Things, are bought and ſold by the *Dozen*, or *Groſs*. *Herrings*, and ſeveral other Sort of Fiſh; and all Sorts of *Nails*, and many ſuch ſmall Things, have ſix Score, or 120, to the Hundred; but a Hundred of *Ling Cod* is 124 in Number; and a Hundred Books in Printing is 104.

Note

Note 2. *Of* PARCHMENT *and* PAPER.

1 Dozen is 12 Skins; 5 Dozen 1 Roll of *Parchment*; 24. and ſometimes 25 Sheets make a Quire of *Paper*, 20 Quires 1 Ream, and 10 Ream 1 Bale.

Note 3. *Of the different Sizes of* BOOKS.

Folio is the largeſt of all Books, and has but 2 Leaves to the Sheet. *Quarto* (marked 4*to*.) has 4 Leaves to a Sheet. *Octavo*, (or 8*vo*.) is a Sheet doubled into 8 Parts; and *Duodecimo* (commonly called *Twelves*, and marked 12*mo*.) has 12 Leaves to the Sheet.

Note 14. *Of* WEIGHT, MEASURE, &c.

A *Faggot* of Steel 6 Score, or 112 *lb*. A *Burthen* or *Gad* of Steel 9 Score. A *Barrel* of Anchovies 30 *lb*. A *Barrel* of Figs from 98 to 300 *lb*. A *Barrel* of Gun-powder 1 *Cwt*. A *Puncheon* of Prunes from 10 to 12 *Cwt*. A *Ton*, or *Fother* of Lead 19 *Cwt*. 2 *qrs*. A *Quintal* of Fiſh 100 in Tale. A *Stone* of Iron, Shot, or Horſeman's Weight 14 *lb*. A *Stone* of Meal 8 *lb*. A *Stone* of Hemp 32 *lb*. A *Stone* of Glaſs 5 *lb*. A *Seam* of Glaſs 24 *Stone*, or 120 *lb* A *Keg* of Herrings, &c. 60 in Number, an *Hundred* is 120. A *Cade* of Sprats 1000. A *Cade* of Herrings 500. A *Barrel* 1200. *A Laſt* 12 Barrels, or 12,000. A *Laſt* of Corn, or Rape-Seed 10 *qrs*. A *Laſt* of Gun-powder 24 Barrels. A *Laſt* of Leather 20 Dickers. A *Dicker* 10 Skins. A *Laſt* of Hides 12 Dozen; of Tar 14 Barrels; of Wool 12 Sacks; of Flax, or Feathers 1700 *lb* A *Wey* in ſome Place is 5 Chaldron. A *Wey* of Meal 6 *qrs*. A *Gallon* of Train Oil 7 $\frac{1}{2}$ *lb*. A *Tun* 252 Gallons. A *Tun* of Sweet Oil 236 Gallons. A *Load* of Hay in ſome Places is 25, in others 30 *Cwt*. In *London* it is ſold in *Truſſes*, containing 56, or 60 *lb*. a Truſs, and 36 Truſſes to the Load. A *Load* of *Scotch* Coals 1 *Cwt*. A *Load* of Tiles 1000.

Of

Of Bricks 500. Bricks in general are 9 Inches long, 4 $\frac{1}{2}$ Inches broad and 2 $\frac{1}{2}$ thick. A *Square* of Tiling or Thatching contains 10 Feet every Way, that is, 100 Feet, and a Rod of Brick-Work 272 Feet, 1 Quarter; but 272 is reckoned for common Work. A *Stack* of Wood is 3 Feet high, 3 Feet wide, and 12 Feet long; but this is according to the Agreement of the Master and the Workmen.

Tyro. I am extremely obliged to you, Sir; but pray am I bound to get these Things by Heart before I learn *Subtraction?*

Philo. Not at all, *Tyro:* Learn the Rules and the common Tables is sufficient. The others I have only added for your further Instruction: They are not set you for a Task, but for Diversion; and if you now and then read them over, you will soon find the Benefit of thus improving your Mind; since it will naturally gain you the Good-will of your Parents, your Master, and Mankind in general, rather than squandering away your Time in Idleness and Mischief, besides the Disgrace of living and dying a Dunce.

SECTION VII.

Contains some useful and diverting Questions to exercise the Learner in Addition *only.*

Quest. 1. A Man borrowed of his Friend a certain Sum of Money, and paid him in Part 15 *l.* 10 *s.* and left unpaid 24 *l.* 10 *s.* What did he borrow? *Ans.* 40 *l.*

Rule. *Add the two Sums together gives you the Answer.*

2. Suppose a Person was born in 1709, when will he be four Score Years old. *Ans.* In 1789.

Rule. *Add as many to* 1709 *as will make it* 1798 *is the Answer.*

3. *A*

3. *A, B,* and *C* agreed to purchase an Estate, *A* laid out, or paid for his Part, 140 *l.* 10 *s.* *B* paid 217 *l.* 10 *s.* *C* paid 500 *l.* 10 *s.* What did the Estate cost? *Ans.* 858 *l.* 10 *s.* Rule. *Add all the Sums together.*

4. A Factor bought 4 Bags of Hops, the first, (No. 1.) weighed 2 *C.* 1 *qr.* 14 *lb.* No. 2. 3 *qrs.* 17 *lb.* No. 3, 2 *C.* 3 *qrs.* 13 *lb.* and No. 4, weighed 1 *qr.* 27 *lb.* What is the Weight of all? *Ans.* 6 *C.* 2 *qrs.* 15 *lb.* *Add all together is the Ans.*

5. A Shop-keeper having opened a Shop, sold the first Day as many Goods as came to 15 *l.* 13 *s.* 7 *d.* $\frac{3}{4}$, and thus he went on for one Week, (*viz.* 6 Days) How much did he take in all? *Ans.* 94 *l.* 1 *s.* 10 *d.* $\frac{1}{2}$.

Rule. *Set down* 15. 13. 7 $\frac{3}{4}$, *six Times, and add them together gives the Answer.*

6. A Farmer carried out 100 *l.* in Order to buy Cattle, and brought Home but 34 *l.* 15 *s.* 6 *d.* What did he lay out? *Ans.* 65 *l.* 4 *s.* 6 *d.* For these two added together make just 100 *l.* and so on for any other Sum.

DIALOGUE III.

SECTION I.

SUBTRACTION *in Whole Numbers.*

Tyro. WHAT does *Subtraction* teach?

Philo. *Subtraction* teaches to take a less *Number* from a *Greater* to discover the *Difference.* To prove the Work, add the *Difference* to the *less Number,* and if the Sum be the same as the *Greater,* the Work is right, otherwise false.

Tyro. How is *Subtraction* performed?

Philo.

Philo. Quite contrary to *Addition*; for in *Addition* you uſe the Word *and*, but *here* you uſe the Word *from*. Thus 4 *from* 7, that is, 4 *taken out of* 7, there remains 3, for the *Difference*. Again, 5 *from* 10, there remains 5; and 6 *from* 14 there remains 8, and ſo for any other Numbers, as you may ſee by the following Examples.

	EXAMPLE 1.	Ex. 2.	Ex. 3.	Ex. 4.
	£.	*Yards*	*Ells*	*lbs.*
Greater Number	27	95	468	441756
Leſſer Number	14	61	162	240256
Difference	13	34	306	201500
Proof	27	95		

The WORK *in Words at length.*

In *Example* 1. I ſay, 4 *from* 7 there remains 3; and 1 *from* 2 there remains 1. *To prove it*, I add the *Difference* to *leſs Numbers*, ſaying, 3 *and* 4 is 7, *and* 1 *and* 1 makes 2. In *Ex.* 2. I ſay 1 *from* 5 there remains 4; *and* 6 *from* 9 there remains 3. *Proof*, I ſay 4 *and* 1 is 5; 3 *and* 6 is 9. That is, 34 *and* 61 added together make 95, and ſo for the other Examples.

Tyro. This is quite plain indeed.

Philo. I ſhall work *Example* 3 and 4 in the ſame Manner, and leave you to prove them as I have directed. Obſerve then, *Ex.* 3. I ſay, 2 *from* 8 there remains 6; then 6 *from* 6, or 6 taken out of 6, there remains 0, and 1 *from* 4 there remains 3. *Laſtly*, in *Ex.* 4. I ſay, 6 *from* 6, there remains 0; then 5 *from* 5 there remains 0; 2 *from* 7 there remains 5; then 0 from 1, that is Nothing taken out of 1, there ſtill remains 1; then 4 *from* 4 there remains 0, and 2 *from* 4, 2.

Note, I ſhall give you an Example or two with, and without Cyphers, that you may endeavour to avoid that idle Cuſtom.

Ex.

Ex. 5. *with Cyph.*		*Without*	Ex. 6. *with Cyph.*	*Without*
From	24526	24526	84257	84257
Take	00012	12	84315	84215
Anſ.	24514	24514	00042	42

Tyro. I own that the Examples without the Cyphers look beſt, and I underſtand very well what you have ſhewn me.

Philo. I ſhall leave you then 3 or 4 Examples for Practice.

	Yards	*Ells*	*Hundreds*
From	47162	94785	347621
Take	12412	3104	301

Tyro. Now Sir, be pleaſed to ſhew me how to ſubtract or manage a Sum, when the lower Figure is ſometimes larger than the Top-one; for I think that it appears difficult to me at preſent.

Philo. Never fear; you will ſoon find it eaſy, if you do but obſerve the following Rule.

2. *When the lower Figure is larger than the Top-one, the* Rule *is,*

Take the lower Figure out of what you do by, which (in *whole Numbers* you know) is *Ten,* and to that Difference, or Remainder, add alſo the Top Figure, and *that* is the true Difference, which place under the firſt Row. This is what is called *Borrowing* in *Subtraction,* therefore, remember that you are always to carry 1 to the next lower Figure for ſo doing: An Example or two will make it quite plain.

	Ex. 1.	Ex. 2.	Ex. 3.	Ex. 4.
	£.	*Ells*	*Yards*	*Bushels*
From	762	85420	760410	5217624
Take	145	17273	457146	3471276
Difference	617	68147		

Here in *Ex.* 1, I say 5 out of 2 I cannot have; therefore I take 5 out of 10 (which is what I do by here) and there remains 5, and the Top Figure 2 makes 7, which I place under the first Row, and carry 1 to the next lower Figure; saying, 1 that I carry to 4 makes 5, which taken out of 6, that is, 5 from 6 there remains 1; but now I carry Nothing to the next Figure, because the lower Figure being less than the Top-one, I had no Occasion to borrow; therefore, I only say in the last Row, 1 from 7, there remains 6: Again, in *Ex.* 2. I say, 3 from 0 I can't, but 3 from 10 there remains 7, and 0 is 7 still; then I carry 1 to 7 is 8, from 2 I can't, but 8 from 10 there remains 2, and the Top Figure 2 makes 4: Then I carry 1 to 2, which is 3, saying, 3 from 4 there remains 1; but now I do not carry any to the next Figure, because I did not borrow, but only say, 7 from 5 I can't take, but 7 from 10 there remains 3, and the Top 5 makes 8. *Lastly,* I carry 1 to 1 is 2 from 8 there remains 6.

Tyro. This is plain enough.

Philo. This is the easiest Way for a Learner, but there is another Method which is more practicable and expeditious, if you mind and learn it.

Another Way to subtract, *when the lower Figure is larger than the Top-one.*

When you cannot take the lower Figure from the Top-one, then count the Top Figure 10 more than it really is. Thus if the Top Figure be 2 call it 12; if 3 call it 13; if 5 call it 15; if 8 call it 18, *&c.* and then

then take the lower Figure from it, and you have the true *Anſwer* or *Difference:* But always remember to carry 1 to the next Figure for ſo doing. This is called borrowing *Ten*, and your carrying 1 to the next Figure is paying of it again.

EXAMPLES.

	£.	*Yards.*	*Ells.*
From	75043	41725	172560
Take	27365	17258	87275
Difference	47678	24467	
Proof	75043	41725	

Firſt, I ſay 5 from 3 I can't; but calling 3, 13, I ſay 5 from 13, there remains 8; then I carry 1 to 6 is 7 from 4 I can't, but I ſay 7 from 14 there remains 7; then I carry 1 to 3 is 4 from 0 I can't, but 4 from 10 there remains 6. Again I carry 1 to 7 is 8 from 5 I can't, but 8 from 17 there remains 7. *Laſtly*, I carry 1 to 2 is 3 from 7 there remains 4.

☞ *Note*, Tho' the Bottom Figures in *Subtraction* may be larger than the Top-ones; yet you are to remember the laſt lower Figure is never larger than the Top-one when there is an equal Number of Figures.

Tyro. I underſtand you very well, Sir.

Philo. Then I ſhall only leave you an Example or two to try at as you have Leiſure.

More EXAMPLES.

	£.	℔.	*Miles.*
From	417215	62170071	417621700
Take	241729	7210943	631720
Difference			

SECTION II.

Of MONEY.

Tyro. HOW is *Subtraction of Money* performed?

Philo. By taking or ſubtracting every Denomination in the lower Line, out of, or from the upper Sum, as will appear more plain by the 2 following Rules.

Rule 1. When the lower Figures in the *Farthings*, *Pence*, or *Shillings*, are ſmaller than the Top-ones; then only ſubtract or take one from the other, and the Remainder is the true *Anſwer*, or *Difference*, which is placed under each Row to which it belongs.

Rule 2. When the lower Figures in the *Farthings*, *Pence*, or *Shillings*, are larger than the Top-ones; then ſubtract or take the lower Figure out of what you do by; that is, take the lower *Farthings* out of 4, the lower *Pence* out of 12, and the lower *Shillings* out of 20, taking in the Top Figure beſides; ſo ſhall this be the true *Difference*, or *Anſwer*; but remember, that you are always to carry 1 to the next Figure for borrowing, as you did in *Whole Numbers*.

Tyro. Pleaſe to give me an Example or two, I ſhall ſoon underſtand it.

Philo. You cannot miſs if you mind the Rule well.

	EXAMPLE 1.			EXAMPLE 2.			EXAMPLE 3.		
	£.	s.	d.	£.	s.	d.	£.	s.	d.
From	9	8	11	48	15	5	643	14	$6\frac{3}{4}$
Take	7	5	6	27	11	3	231	11	$2\frac{1}{4}$
Remains	2	3	5	21	4	2	412	3	$4\frac{1}{2}$
Proof	9	8	11	48	15	5	643	14	$6\frac{3}{4}$

1. I

1. I begin at the Pence in *Example* 1, saying, 6 from 11 Pence, there remains 5 Pence, which I place under the Pence: Then I say 5 Shillings from 8, there remains 3 Shillings; and 7 Pounds from 9, there remains 2. So is the *Difference* 2 *l.* 3 *s.* 5 *d.*

PROOF.

The Work is proved like *whole Numbers*, by adding the *Difference* to the *lower*, or *less Number*: Thus 5 Pence and 6 is 11 Pence; then 3 Shillings and 5 make 8 Shillings; and 2 added to 7 make 9 Pounds.

2. In *Example* 2, I say 3 from 5 there remains 2 Pence; then 11 from 15 there remains 4; then 7 from 8 there remains 1; and 2 from 4 there remains 2. *Ex.* 3, having Farthings, I say 1 Farthing from 3 there remains 2 Farthings, which I set down thus $\frac{1}{2}$; then 2 from 6 there remains 4 Pence; then 11 from 14 Shillings there remains 3. *Lastly*, for the Pounds I say, 1 from 3 there remains 2; then 3 from 4 there remains 1; and 2 from 6 there remains 4: So is the *Difference* or *Answer* 412 *l.* 3 *s.* 4 *d.* $\frac{1}{2}$. Now if you *add* this 412 *l.* 3 *s.* 4 *d.* $\frac{1}{2}$ to the lower Sum 231 *l.* 11 *s.* 2 *d.* $\frac{1}{4}$, you will find they amount to the same as the Top Sum, *viz.* 643 *l.* 14 *s.* 6 *d.* $\frac{3}{4}$.

Note, After this Manner is every Sum done and proved in *Subtraction*.

More Examples for Practice.

	£.	s.	d.	£.	s.	d.	£.	s.	d.
From	471	11	$2\frac{1}{4}$	576	19	$11\frac{1}{2}$	409	11	$5\frac{1}{4}$
Take	120	10	2	132	13	$4\frac{1}{4}$	304	11	$3\frac{1}{2}$
Remains									

2. *When the* Shillings, Pence, *and* Farthings *are larger in the lower Line than in the Top-one.*

	EXAMPLE 4.			EXAMPLE 5.			EXAMPLE 6.		
	(10	(20)	(12)	(10)	(20)	(12)	(10)	(20)(12)	(4)
	£.	s.	d.	£.	s.	d.	£.	s.	d.
Lent	10	4	6	42	11	6	453	13	$5\frac{1}{4}$
Received	7	10	8	17	14	10	326	15	$8\frac{3}{4}$
Due	2	13	10	24	16	1	126	17	$1\frac{1}{2}$
Proof	10	4	6	42	11	6	453	13	$5\frac{1}{4}$

Here I ſay 8 Pence from 6 Pence I can't; but 8 from 12 (which is what I do by at Pence) there remains 4, and the Top 6 makes 10: Then I carry 1 becauſe I borrowed, ſaying, 1 that I carry to 10 is 11 Shillings, which from 4 I can't take; but 11 from 20 (which is what I do by) there remains 9, and the Top 4 makes 13. *Laſtly*, I carry 1 to 7 is 8 from 10 there remains 2.

PROOF.

I prove theſe Examples the ſame Way as before, by adding the *Difference* to the *leſs Sum*, ſaying, 10 Pence, and 8 is 18 Pence, that is, 6 Pence above a Shilling, or 12 Pence; and I carry 1 to 13 is 14, and 10 is 24, which is 4 above 20 Shillings, or 1 *l*. *Laſtly*, I carry 1 to 7 is 8, and 2 makes 10.

Now *Tyro*, pray try you at *Example* 6, where there are Farthings.

Tyro. In *Example* 6, I ſay firſt, 3 Farthings from 1 Farthing I can't; but 3 Farthings from a Penny, or 4 Farthings, there remains 1, and the Top Farthing makes 2 Farthings, which I ſet down thus $\frac{1}{2}$: Then I carry 1 to 8 Pence is 9 Pence, which from 5 Pence I can't have; but 9 from 12 there remains 3, and the Top 5 makes

makes 8 Pence: Again, I carry 1 to 15 is 16, from 13 I can't; but 16 from 20 there remains 4, and the Top 13 is 17 Shillings. *Lastly*, I carry 1 to 6 is 7 from 3 I can't; but 7 from 13 there remains 6. Or 7 from 10 there remains 3, and the Top 3 is 6: Then I carry 1 to 2 is 3 from 5 there remains 2; but now carry none because I did not borrow; therefore I only say 3 from 4 there remains 1.

PROOF.

I prove this, as before directed, saying, 2 Farthings and 3 is 5 Farthings, which is 1 Farthing above a Penny, and I carry a Penny to 8 is 9, and 8 is 17 Pence, 5 above 12, and I carry 1 to 17 is 18, and 15 is 33, which is 13 above 20, and I carry 1 to 6 is 7, and 6 is 13, which is 3 above 10, and I carry 1 to 2 is 3, and 2 is 5; then I say 1 and 3 is 4.

Philo. You have done very well indeed: I shall only set you an Example or two for Practice.

EXAMPLES *for Practice.*

	£.	s.	d.		£.	s.	d.
Borrowed	217 -	10 -		*Debtor*	1000 -	-	-
Paid	109 -	15 -	$8\frac{1}{4}$	*Creditor*	910 -	15 -	$6\frac{1}{2}$
To pay				*Balance*			

Tyro. These I can do very well; therefore wish you would shew me how to balance an Accompt, or make out a small Reckoning.

Philo. That I will.

3. *Practical Questions for Business.*

		£.	s.	d.
Quest. 1. *A* borrowed of *B*	——	100	-	-

	£.	s.	d.
A paid him at one Time	21	14	6
At another 10 Guineas, *viz.*	10	10	-
At another 20 Guineas, *viz.*	21	-	-
At another Time	5	15	-
Sold him Goods amounting to	18	14	9
	77	14	3

		£.	s.	d.
	In all	77	14	3
What is still due to *B*?	*Answer*	22	5	9

Rule. I add up together all the Sums that *A* paid at different Times, and find they amount to 77 *l.* 14 *s.* 3 *d.* which I place under 100 *l.* and subtracting it therefrom, I find that there is still due to *B* 22 *l.* 5 *s.* 9 *d. Answer.*

Quest. 2. *A* Blacksmith *delivered a Bill to a* Farmer *of* 45 *l* 14 *s* 6 *d.* $\frac{1}{4}$, *and the Farmer has paid him in Part as under.*

	£.	s.	d.
By Cash —— ——	20	-	-
By 10 Bushels of Malt —— ——	1	15	-
By a Load of Hay ——	1	16	-
By Meat at several Times ——	2	7	6
By 14 Bushels of Oats ——	2	11	-
By 20 Bushels of Wheat ——	4	7	3
	32	16	9

	£.	s.	d.	
Blacksmith's Bill ——	45	14	$6\frac{1}{4}$	
Farmer's Bill ——	32	16	9	
Balance due to the *Blacksmith*	12	17	$9\frac{1}{4}$	*Answer*

Quest.

Quest. 3. A *Steward* collected as much Money for Rents as amounted to —— £.4000.
And remitted to his Master as under.

By Cash at one Time ——	500		
At another —— ——	500		
At another —— ——	210		
At another ——	420		
By Tax-Bills discounted	41	15	$6\frac{1}{4}$
By Repairs done to the Estate ——	641	14	9
By other Charges ——	15	13	6
Laid out in all	£.2329	3	$9\frac{3}{4}$
Which taken from the Top £.4000			
there remains due to his Master	1670	16	$2\frac{1}{4}$

Tyro. I understand you well.

Philo. Then I will leave you one *Question* for Practice, and you may do the Work at Leisure.

Quest. 4 Two Persons *A* and *B* have a Reckoning to settle as follows: *A* lent *B* £. 300, and some Time after lent him 100 Guineas more: *B* paid him at 3 several Times, each 100 Guineas, and at another Time gave him a *Draught* or *Note* upon *C*, for £. 50, and sold him as many Goods as came to £. 34 - 4 - 6: Now I demand how the Balance stands between them. *Ans.* There is still due to *A* £. 5 - 15 - 6. To prove it,

Rule. Add the two Sums that *A* lent to *B* together, and you will find them £. 405; then set all that *B* paid in Cash, and the *Draught*, and Goods, all under one another, and add them together, which makes £. 399 - 4 - 6: This being done, set £. 399 - 4 - 6 under £ 405, and *subtract* it therefrom, and you will find there remains £. 5 - 15 - 6 due to *A* on Balance.

Tyro. I will try it directly, and am sure it is easy enough, but your Answer will be some Help to me I own.

Philo. As every Accompt of *Debtor* and *Creditor* is settled after this Manner, I shall give no more Examples,

expecting by this Time you are capable of setting yourself Questions; and if you are not, it is highly necessary to look over the Examples once more, then will you be duly qualified for those Questions I shall set you at the End of *Subtraction*: And therefore we will proceed to *Weights* and *Measures*, where you will find some Examples done for your Instruction, and some left undone for your Practice.

AVOIRDUPOIS WEIGHT.

	Tons	*C.*	*qr.*	*lb.*		*C.*	*qr.*	*lb.*	*oz.*	*dr.*
Bought	17	11	1	15	*Bought*	47	1	17	11	14
Sold	14	17	3	21	*Sold*	19	0	25	10	15
Unsold	2	13	1	22	*Unsold*					

Now *Tyro* I shall shew you this first *Example*, but no more; because all other Sums in every one of the Rules are done in the same Manner, and there is no Occasion for further Instruction.

First, I say 21 from 15 I can't; but 21 from 28 (which is what I do by at *lbs.*) there remains 7, and 15 makes 22: Then I carry 1 to 4 is 4 from 1 I can't; but 4 from 4 (which is what I do by at *qrs.*) there remains 0, but the Top 1 is 1, which I set down. Again, I carry 1 to 17 is 18 from 11 I can't; but 18 from 20 there remains 2, and the Top 11 makes 13. *Lastly*, I carry 1 to 4 is 5 from 7, there remains 2, and the Work is done.

Tyro. I thank you Sir; Examples now without Words will be sufficient.

Note, If you forget what you do by, turn to your Tables in *Addition*.

TROY-

TROY-WEIGHT.

	lb.	*oz.*	*dw.*	*gr.*		*lb.*	*oz.*	*dw.*	*gr.*
Bought	14 –	5 –	15 –	14	*Bought*	214 -	10 -	17 -	11
Sold	9 –	9 –	13 –	17	*Sold*	109 -	10 -	17 -	15
Rem.	4 –	8 –	1 –	21	*Remains*				

DRY-MEASURE.

	Loads	*Bush.*	*Pecks*	*Pints*		*Chal.*	*Bush.*	*Pecks*
Bought	42 –	17 –	2 –	12	*Bought*	291 –	21 –	2
Sold	17 –	34 –	2 –	14	*Sold*	173 –	27 –	3
Unsold	24 –	22 –	3 –	14	*Unsold*			

WINE-MEASURE.

	Butts	*Hhds.*	*Gall.*	*Pints*		*Hhds.*	*Gall.*	*Pints*
Bought	14 –	1 –	47 –	0	*Bought*	64 –	35 –	1
Sold	9 –	0 –	51 –	5	*Sold*	17 –	46 –	2
Unsold	5 –	0 –	58 –	3	*Unsold*			

WINCHESTER-MEASURE.

	Bar.	*Gall.*	*Pints*		*Butts*	*Hhds.*	*B.*	*Gall.*
Brewed	124 –	21 –	4	*Brewed*	21 –	1 –	1 –	20
Sold out	92 –	27 –	6	*Sold out*	15 –	1 –	0 –	26
Unsold	31 –	29 –	6	*Unsold*				

Note, I have reckoned 36 Gallons to the Barrel, that being customary in selling Beer in most Places, as I said before.

CLOTH-MEASURE.

	Yds.	qrs.	Nails	Ells Eng.	qrs.	N.	Ells Fl.	qurs.	N.
Bought	147	1	0	47	1	3	47	2	0
Sold	96	3	2	18	2	3	29	2	1
Rem.	50	1	2						

LONG-MEASURE.

	Deg.	Leag.	Miles	Fur.	Rods	Yds.	Feet	Inc.	B. Corns
From	471	14	1	3	17	2	1	10	1
Take	167	17	1	5	21	3	1	10	2
Rem.	303	16	2	5	35	3½	2	11	2

LAND-MEASURE.

	Acres	Roods	Poles	Yds.	Acres	Roods	Poles
From	471	2	15	3	47	1	15
Take	196	2	26	4	19	2	29
Rem.	274	3	28	4½			

TIME.

	Years	Mths.	Weeks	Days	Hours	Days	Hours	Min.	Sec.
From	219	10	3	3	17	45	17	25	17
Take	193	11	3	4	20	19	21	43	35
Rem.	25	11	3	4	20				

Note, In the first Example I reckon 13 Months to a Year.

Tyro. Sir, I am obliged to you for the Pains you have taken; I underſtand you very well, and will try at all thoſe Sums you have left undone.

Philo.

Philo. That is enough, we will finish *Subtraction* then with *Section* 3.

SECTION III.

Containing some useful QUESTIONS *to exercise the Learner in both* RULES.

Quest. 1. KING *Harry* the Eighth died 1547; I demand how many Years it is, this being now 1754. *Answer* 207 Years.

Quest. 2. Suppose this present Year 1754 you were 19 Years old, what Year was you born in. *Ans*. 1735.

Quest. 3. A Boy had 1000 Marbles, and he lost at 3 different Times at Play, each 175, and at another Time 150; how many has he still in Hand? *Ans*. 325.

Rule. Set down 175 three Times, and 150 under that; and then add all of them together, and take the Sum out of 1000, and the Answer will be 325 left. This *Rule* serves for all that follows.

MONEY.

4. *A* lent *B* £. 500, and *B* paid him 4 Times, each £. 120, 10 *s*. What is due to *A*? *Ans*. £. 18.

5. What Sum of Money must I add to £. 58-14-6$\frac{3}{4}$, to make it up £. 100? *Ans*. £. 41-5-5$\frac{1}{4}$.

6. *A Proof to Question* 5. What Sum must I take out of £. 100, to have the Remainder £. 58-14-6$\frac{3}{4}$ *Answer* £. 41-5-5$\frac{1}{4}$.

7. A Collector of the Excise received £. 2040-14-5$\frac{1}{4}$ and remitted, or paid at 3 several Times, each £ 500, and at another Time 100 Guineas: What has he still in Hand? *Ans*. £. 435-14-5$\frac{1}{4}$.

AVOIRDUPOIS-WEIGHT.

8. Bought 6 *Ton*, 14 *Cwt*. of Iron, and ſold at one Time, 3 *Ton*, 11 *C*. 2 *qrs*. and at ſeveral other Times, ſold by Retail 15 *C*. 3 *qrs*. 17 *lb*. What remains unſold? *Anſ*. 2 *Ton* 6 *C*. 2 *qr*. 11 *lb*.

TROY-WEIGHT.

9. A Gentleman delivered to a Silverſmith 2 *lb*. 5 *oz*. 11 *dwts*. of Silver; and he received a Silver Cup, which weighed 11 *oz*. 14 *dwts*. and at another Time, 6 large Spoons, weighing 1 *lb*. 2 *oz*. 3 *dwts*. 14 *grs*. What Weight of Silver has the Silverſmith ſtill in Hand? *Anſ*. 3 *oz*. 13 *dwts*. 10 *grs*.

LIQUID-MEASURE.

10. A common Brewer has 2 Goils of new Beer, containing 32 Butts, 2 Barrels, 24 Gallons of Strong; and 15 Butts 1 Barrel of Small. And he ſent to one Victualler 8 Butts, 2 Barrels, to another 11 Butts, and ſtarted into his own Store-houſes 5 Butts, 2 Barrels, 27 Gallons of the Strong; and of the Small 7 Butts, 2 Barrels; he alſo ſold out by Retail of the Small, 4 Butts, 23 Gallons: I demand what remains of the Brewing, both of the Goil of Strong, and the Goil of Small? *Anſ*. 7 Butts, 33 Gallons of Strong, and 3 Butts, 1 Barrel, 13 Gallons of Small.

☞ *Note*, I have added the Anſwers, that you may know when you are right or wrong: If you cannot do all theſe Queſtions as yet, it is of no great Signification; you muſt not ſtop your Progreſs in going forward, becauſe of that. Now follows

DIA-

DIALOGUE IV.

MULTIPLICATION.

SECTION I.

Tyro. WHAT is *Multiplication?*

Philo. *Multiplication* is a compendious or ſhort Way of *Addition*, and teaches us to tell the Product of a Sum in one Line only, which would require ſeveral *Additions*.

Tyro, What elſe is required?

Philo. There are three Things to be careſully obſerved in *Multiplication*.

Firſt. The *Multiplicand*, which ſtands a-top, and is that Number given to be multiplied.

Secondly, The *Multiplier*, or Sum you multiply by.

Thirdly, The *Product*, or *Anſwer*, which is the *Multiplicand* multiplied by the *Multiplier*.

Tyro Pleaſe to explain this a little more.

Philo. Let us take any two Numbers, ſuppoſe 8 and 3, I ſet down 8, and place 3 under it; ſo is 8 the *Multiplicand*, 3 is the *Multiplier*, and 24 is the *Product*, or *Anſwer*, becauſe 3 Times 8 make 24. Is this plain enough.

Tyro. Yes Sir, I underſtand you now.

Philo. Very well, *Tyro*, then I would have you get the following Table by Heart, by all Means, notwithſtanding it is too cuſtomarily omitted.

MULTIPLICATION TABLE.

Once 1 is 1

2 Times, or Twice	2	is	4
	3		6
	4		8
	5		10
	6		12
	7		14
	8		16
	9		18
3 Times	3	is	9
	4		12
	5		15
	6		18
	7		21
	8		24
	9		27
4 Times	4	is	16
	5		20
	6		24
	7		28
	8		32
	9		36
5 Times	5	is	25
	6		30
	7		35
	8		40
	9		45
6 Times	6	is	36
	7		42
	8		48
	9		54
7 Times	7	is	49
	8		56
	9		63
8 Times	8	is	64
	9		72
9 Times	9	is	81
10 Times	10		100
11 Times	11		121
12 Times	12		144

Table of Twelves.

12 Times	2	is	24
	3		36
	4		48
	5		60
	6		72
	7		84
	8		96
	9		108
	10		120
	11		132
	12		144

Note 1. You ſhould be very careful to get the *Table* by Heart, as I ſaid before: Saying thus, 2 Times 2, or twice 2 is 4, twice 3 is 6, twice 4 is 8, twice 5 is 10, *&c.*

Note 2. You ſhould alſo at Leiſure learn to *box* the *Table* well; that is, to ſay it backwards, forwards, or any Way. Thus you ſee twice 5 is 10, that is, 5 Times 2 is 10: Again, 3 Times 9 is 27; ſo alſo is 9 Times 3 the

the ſame. So 6 Times 12 is the ſame as 12 Times 6, and 5 Times 9 the ſame as 9 Times 5.

1. *To multiply by ſingle Figures.*

Rule. Multiply every Figure in the *Multiplicand* by the Figure in the *Multiplier*, carrying 1 for every 10, as in *Addition of whole Numbers*, and you have the *Product* or *Anſwer*.

EXAMPLE 1.		EXAMPLE 2.	
Multiplicand	17	*Multiplicand*	78
Multiplier	5	*Multiplier*	6
Product	85	*Product*	468

I begin with the *Multiplier* 5, ſaying, 5 Times 7 is 35, and ſet down the 5, and I carry 3; then I ſay 5 Times 1 is 5, and 3 that I carried is 8; ſo is the *Product*, or *Anſwer*, 85. Again,

In *Ex.* 2. I ſay, 6 Times 8 is 48; that is 8, and I carry 4; then 6 Times 7 is 42, and 4 I carried is 46: So is this *Product* 468.

To prove the Work by ADDITION.

I ſet the *Multiplicand* 17 down 5 Times; and the *Multiplicand* 78 I ſet down 6 Times, and adding them together, (ſeparately) I find 85, and 468, as before; which you may try on your Slate at Leiſure.

Tyro. I ſee plainly that *Multiplication* ſaves the Trouble of many *Additions*.

Philo. There is another Way to prove *Multiplication*; but that we ſhall ſpeak of by and by.

Ex-

EXAMPLE 3.	EXAMPLE 4.	EXAMPLE 5.
Multiply 472	249070	and 590407
by 8	*by* 9	*by* 7
Answer 3776	*Anf.* 224730	*Anf.* 4132849

Tyro. I say 8 Times 2, (or twice 8) is 16, 6 and I carry 1; then 8 Times 7 is 56, and 1 is 57; that is, 7, and I carry 5; then 8 Times 4 is 32, and 5 I carried is 37. In *Ex.* 4, I say, 9 Times (0) Nothing is 0; then 9 Times 7 is 63, that is 3, and I carry 6; then 9 Times 9 is 81, and 6 I carried is 87, that is 7, and I carry 8; then 9 Times 4 is 36, and 8 is 44, that is, 4 and I carry 4; and *lastly*, 9 Times 2 is 18, and 4 I carried is 22. Also in *Ex.* 5, I say, 7 Times 7 is 49, that is 9, and I carry 4; 7 Times 0 is 0, but 4 is 4 still; then 7 Times 4 is 28, that is 8, and I carry 2; then 7 Times 0 is 0, but 2 is 2; then I carry none, but say, 7 Times 9 is 63, that is 3, and I carry 6; and *lastly*, 7 Times 5 is 35, and 6 is 41.

Philo. Very well done indeed! I leave these two Examples for Practice.

Multiply 49997296	and 94171470
by 9	*by* 8
Answer	*Answer*

Tyro. Please to give me an Example or two to *multiply* by 12 in one Line; for I know it is done much quicker, and it is as easy as to make two of it.

EXAMPLES *with Twelves.*

Multiply 42576	and 994079	and 99807
by 12	*by* 12	*by* 12
Answer 510912	*Anf.* 11928948	*Anf.*

First,

First, 12 Times 6 is 72, that is 2, and I carry 7; then 12 Times 7 is 84, and 7 I carried is 91, that is 1, and I carry 9; then 12 Times 5 is 60, and 9 I carried is 69, that is 9, and I carry 6; then 12 Times 2 is 24, and 6 is 30, that is 0, and I carry 3; and *lastly*, 12 Times 4 is 48, and 3 is 51. And thus by having the *Table of Twelves* perfectly by Heart, every Sum will be easy to you.

Tyro. It is easy enough, I see: Please now to shew me how you multiply by 2, 3, 4, or more Figures.

Philo. This you will soon understand.

2. *Of multiplying by several Figures.*

Rule. When there are several Figures in the *Multiplier*, then you begin at the first Figure in the Units Place, and multiply it through, or into every Figure of the *Multiplicand*, as you have done before. This being done, multiply every Figure in the *Multiplicand* by the second Figure of the *Multiplier*; only observe to set the first Figure of this second Row under the *Tens Place* of the first Row; and thus you go on with the third Figure in the *Multiplier*, placing the *Units Place* of each succeeding Row under the *Tens Place* of the Row that is above it, till you have gone through every Figure of the *Multiplier*. Then draw a Line under all the Rows of Figures, and add them together, and the Sum is the true *Product*, or *Answer*.

Note, Be sure you remember that you set your Figures right under one another, or else in a large Sum you will be puzzled to add the Work together.

Ex.

EXAMPLES *with several Figures.*

EXAMPLE I.		PROOF.	
Multiply	89	*Multiply*	47
by	47	*by*	89
	623		423
	356		376
Answer	4183	*The same*	4183

In *Example* 1, I ſay, 7 Times 9 is 63, that is 3, and I carry 6; then 7 Times 8 is 56, and 6 I carried is 62, which I ſet down; ſo is the firſt Line or Row finiſhed: Then I take the ſecond Figure of the *Multiplier*, ſaying, 4 Times 9 is 36, which 6 I ſet under the 2, or *Tens Place* of the firſt Line, and carry 3; and then I ſay, 4 Times 8 is 32, and 3 that I carried is 35, placing the 5 under the 6, and the 3 quite out towards the Left-hand. *Laſtly*, I add theſe up in Order, as they ſtand, ſaying, 3 is 3; then 6 and 2 is 8; again, 5 and 6 is 11, that is 1, and I carry 1 to 3 is 4.

To prove MULTIPLICATION.

It is a common Way to prove *Multiplication* by the Croſs; but it is ſubject to ſo many Errors, that in ſhort, it is no Proof at all to a Learner, but rather a Corruption. The beſt Way therefore is this: Take the *Multiplicand*, and ſet it below, and the *Multiplier* a-top, that is, change the *Multiplicand* into the *Multiplier*, and proceed as before directed, and if the *Product* be the ſame as before, your Work is entirely right. See the next Examples wrought at large both Ways.

EXAMPLE 3.		PROOF.	
Multiplicand	895	*Multiplicand*	798
Multiplier	798	*Multiplier*	895
	7160		3990
	8055		7182
	6265		6384
Product	714210	*The same*	714210

First, I ſay, 8 Times 5 is juſt 40; therefore I ſet down the 0, and carry 4; then 8 Times 9 is 72, and 4 I carried is 76, that is 6, and I carry 7; then 8 Times 8 is 64, and 7 I carried is 71. Now I take the ſecond Figure, ſaying, 9 Times 5 is 45; which 5 I place under the ſecond Figure, or *Tens Place* of the firſt Line, and carry 4, ſaying, 9 Times 9 is 81, and 4 is 85, which 5 I place under the Figure 1, and carry 8 to the next Figure, ſaying, 9 Times 8 is 72, and 8 that I carried is 80. And now I come to the laſt Figure of the *Multiplier*, ſaying, 7 Times 5 is 35, which 5 I place under the ſecond Figure of the laſt Line, and carry 3 to the next Figure; ſaying, 7 Times 9 is 63, and 3 I carried is 66, that is, 6 and I carry 6; then 7 Times 8 is 56, and 6 is 62. *Laſtly*, I add theſe up in Order, as they ſtand, and find the *Product* 714210.

The Proof of this Example is worthy your Obſervation, *Tyro*; for be the Sum ever ſo large, if you change the *Multiplicand* into the *Multiplier*'s Place, and multiply right, you will find the *Product* always the ſame.

Tyro. I ſee it plainly, Sir; and I could not have thought *Multiplication* had been ſo eaſy.

Philo. Nothing eaſier, when the *Table* is once well learned. I ſhall now give you two more Examples, and leave the reſt undone for Practice.

EXAMPLE 4.

Multiply	913876
by	8759
	8224884
	4569380
	6397132
	7311008
	8004639884

EXAMPLE 5.

and	749076
by	1795
	87454380
	6741684
	5243532
	749076
	1344591420

EXAMPLES *for Practice.*

Multiply	4567879
by	45769

Multiply	9567950
by	32796

☞ *Note*, Remember *Tyro*, that when you multiply by ſeveral Figures, that you always ſet the firſt Figure of the ſecond Line under the ſecond Figure of the firſt Line, and the firſt Figure of the third Line under the ſecond Figure of the ſecond Line; and thus go on, leaving one Figure out towards the Right-hand every Line, ſetting the next Line one Figure more towards the Left-hand, and every Figure under one another in their proper Place.

Tyro. I underſtand you well, Sir.

Philo. Then I will ſet you but one Example more, which you may prove yourſelf.

Multiply

Multiply	987654321
by	123456789
	8888888889
	7901234568
	6913580247
	5925925926
	4938271605
	3950617284
	2962962963
	1975308642
	987654321
Answer	121932631112635269

PROOF.

Multiply	123456789
by	987654321

3. *Of Cyphers between the Figures, &c.*

The most difficult Thing in this Rule, is when the *Multiplier* has some Figures, some Cyphers; but if you be careful to mind the Work of an Example or two, you will soon understand it, as I shall explain them in Words.

EXAMPLE 1.

Multiply	49657
by	30705
	248285
	3475990
	1489710
Answer	1524718185

EXAMPLE 2.

Multiply	7564965
by	5003007000
	52954755000
	2269489500
	3782482500
Answer	37847572849755000

Note,

Note, Pray observe, that you read the following Instructions once or twice over, if you do not understand the Work.

First, I begin at the 5, and multiply all the Top Figures by it, as before: Now, as the next Figure of the *Multiplier* is a Cypher, it is of no Signification to multiply by *that*, because it will produce Nothing but a Line of Cyphers: Therefore, I bring it down, that is, I set a Cypher under the Figure 8, and then begin to multiply by the 7, saying, 7 Times 7 is 49, 9 and I carry 4; which 9 I set down in the same Line, on the Left-hand of the Cypher, and go on still to multiply by the 7; then as the next Figure is a Cypher again, I set down a Cypher under it, as I did before, leaving the 9, and the Cypher which stands by it, in the last Line, both standing out towards the Right-hand. This being done, I only multiply by the 3, and set it in the same Line, and add all up, and the Work is done. Again,

In *Example* 2, there are 3 Cyphers at the Beginning of the *Multiplier*, therefore I set 3 Cyphers under the Line, right under them: Then multiply by the 7 as in all other Sums; saying, 7 Times 5 is 35, *&c.* Then I come to 2 Cyphers more in the *Multiplier*, and therefore, I set 2 Cyphers right under them, and then multiply by the 3, and place the Product by the Side of the 2 Cyphers: Then, as there are two Cyphers, I again set down two Cyphers, thus, 00, under them, and then multiply by the 5, placing the Product by the Side of them. *Lastly*, I add the Sum up as it stands, and it is done.

Note, These Examples are proved like the others, by setting the *Multiplier* a-top, and the *Multiplicand* under it.

More

More Examples for Practice.

Multiply	570965	and		71900072
by	2400500		*by*	5000960000

And now *Tyro,* I ſhall finiſh this *Section* with ſhewing you ſomething of *Contractions*, or *Compendiums.*

4. *Of* CONTRACTIONS.

When any Number of Figures are given to be multiplied by 10, 20, 30, 40, 80, 90, 120, 1200; then ſet the Cyphers out, and multiply by the Figure, or Figures, and place the *Product* by the Side of the Cyphers, as before, gives the *Anſwer*.

Multiply	275	and		3275	and	6759
by	20		*by*	90	*by*	1200
Anſwer	5500		*Anſ.*	294750	*Anſ.*	8110800

2. When you are to multiply by 1, the *Anſwer* will be the ſame as the *Multiplicand* itſelf is. If you are to multiply by 10, add 1 Cypher to the *Multiplicand*; if by 100, add 2 Cyphers; if by 1000, add 3 Cyphers: See the Work two Ways.

Multiply	1753		1753		1753
by	100		1000		10000
Anſ.	175300	*Anſ.*	1753000	*Anſ.*	17530000

Or rather thus:

Multiply 1753 *by* 1	*Answer* the same, *viz.*		1753
by 10	add 1 Cypher,	*Ans.*	17530
by 100	add 2 Cyphers,	*Ans.*	175300
by 1000	add 3 Cyphers,	*Ans.*	1753000
by 10000	add 4 Cyphers,	*Ans.*	17530000

And thus for as many Cyphers as you please.

Tyro. The Examples are quite plain and easy.

Philo. I am glad that you understand them; for now I shall shew you *that* which will serve you for all common Business, in casting up any Sort of Goods; and pray be careful to mind it well; for there is not a more useful Thing in all common *Arithmetic*, it being a short Way of working the *Rule of* 3, without *Division*.

QUESTIONS *performed by* Multiplication.

Tyro. How are these Questions performed?

Philo. By the following Rule, *viz.*

Multiply the Price by the given Number, or Quantity, and carry 1 for every 4, 12, and 20, as you do in *Addition of Money*, and 1 for every 10 in the Pounds, as in *Whole Numbers*.

An Example or two well explained will soon make it easy to you.

	£.	s.	d.	
Quest. 1. What cost 3 Ells, at	0 –	5 –	3	an Ell?
			3	
	£. 0 –	15 –	9	*Ans.*

Here I multiply the Price by the Quantity; saying, 3 Times 3 is 9 Pence, which I place under the Pence; and then say, 3 Times 5 Shillings is 15, which I place under the Shillings, and the Answer is 15 Shillings and 9 Pence.

☞ You

☞ You must remember, that 3 Ells, at 5 *s.* 3 *d.* an Ell, is the same as 3 Yards, or 3 Grofs, or 3 Gallons, or any other Name whatsoever; for it is only 3 Times 5 Shillings, and 3 Pence.

2. What comes 5 Grofs of any Thing to, at } £. 0 – 6 – 8 a Grofs?

	£.	s.	d.	
	0	6	8	a Grofs?
			5	
£.	1	13	4	*Anf.*

Here I multiply the Price by 5, saying, 5 Times 8 is 40 Pence, (which is 3 Shillings and 4 Pence) therefore I set down 4 under the Pence, and carry 3, and then 5 Times 6 Shillings is 30, and 3 I carried is 33 Shillings, which is 1 *l.* 13 *s.* that is 13, and I carry 1; and then I say, 5 Times 0 is 0, but 1 is 1.

3. How much does 7 Times 8 Shillings and 9 Pence amount to? Or,
What cost 7 Reams of Paper at }

	£.	s.	d.	
	0	8	9	a Ream
£.	3	1	3	*Anf.*

Here I say, 7 Times 9 is 63 Pence, which is 5 Shillings, and 3 Pence, that is 3, and I carry 5; then 7 Times 8 is 56 Shillings, and 5 I carried is 61; that is 3 *l.* 1 *s.* or, which is the same, it is 3 Twenties, and 1 over; therefore, I set 1 under the Shillings, and carry 3 to the Pounds, saying, 7 0 is 0, but 3 is 3: So is the Answer 3 *l.* 1 *s.* 3 *d.*

Note, Tho' I have set Cyphers in the Place of Pounds in these Examples, and have also set *L. s. d.* over the Sums, yet it is better to leave out the Cyphers, and more practicable, to make only a great £. before the Pounds, as in the following Examples.

4. What

4. What coſt 9 Gallons of Brandy, or any Thing elſe, at —— —— —— £. – 8 $3\frac{1}{2}$ a Gallon

9

£. 3 – 14 $5\frac{1}{4}$

Here I multiply the Price by 9, beginning at the Farthings, ſaying, 9 Farthings is 2 Pence Farthing, that is 1 Farthing, and I carry 2 Pence; then 9 Times 3 is 27 Pence, and 2 Pence I carried is 29 Pence, which is 2 Shillings, and 5 Pence; therefore, I ſet down 5 under the Pence, and carry 2, ſaying, 9 Times 8 is 72 Shillings, and 2 I carried is 74. Now 74 Shillings is 3 *l.* 14 *s.* therefore, as there is Nothing in the Pounds to multiply, I ſet down 3 *l.* 14 *s.* *viz.* the 14 under the Shillings Place, and the 3 towards the Left-hand.

Tyro. This is very pretty, and very eaſy: Pleaſe to try me with an Example.

Philo. There is no Doubt but you will do it.

5. A Gentleman gave 10 poor Widows three Half Crowns a-piece: How much did he give in all? Or thus, What coſt 10 Buſhels of any Thing, at a Buſhel } £. – 7 – 6

10

£. 3 – 15 – 0

Tyro. I ſet down 3 Half Crowns, that is, 7 *s.* 6 *d.* and multiply it by 10, ſaying, 10 Times 10 is 60 Pence, that is juſt 5 Shillings; therefore, I ſet down Nothing (0) and carry 5; then I ſay, 10 Times 7 is 70, and 5 I carried is 75 Shillings; which is 3 *l.* 15 *s.* So is the Anſwer £. 3 – 15

6. What

6. What comes 12 Months Wages to, at } £. 1 – 8 – 6¼ a Month?

12

Anf. £. 17 – 2 – 3

Or how much is 12 Times £. 1 – 8 – 6¼

Here I ſay, 12 Farthings is 3 Pence, that is 0, and I carry 3; then 12 Times 6 is 72, and 3 I carried is 75 Pence, which is 6 *s.* 3 *d.* I therefore ſet down 3, and carry 6; then I ſay, 12 Times 8 is 96 Shillings, and 6 I carried is 102 Shillings, which is 5 *l.* 2 *s.* ſet down 2, and carry 5; then I ſay 12 Times 1 is 12, and 5 I carried is 17 *l.* So is the Anſwer £. 17 – 2 – 3.

2. *Of double Figures in the Shillings.*

When you come to double Figures, ſuch as 14, 17, 18, or the like, multiply them like *Whole Numbers*, and then caſt out the Twenties, that is, count how many Times 20 you can have in the Number, and it is done. There are ſeveral other Ways I ſhall ſhew you, and always take *that* which appears eaſieſt to you, till perfect.

7. What coſt 5 Sheep, at £. 1 – 17 – 6 each? Or, what is 5 Times £. 1 – 17 – 6

5

Anſ. £. 9 – 7 – 6

Here I ſay 5 Times 6 is 30 Pence, is 2 *s.* 6 *d.* that is 6 and I carry 2; then I multiply the whole 17 by 5, ſaying 5 Times 7 is 35, and 2 I carried is 37, 7 and I go 3, then 5 Times 1 is 5, and 3 is 8, that is 87 Shillings, which is 4 *l.* 7 *s.* that is 7, and I carry 4; then 5 Times 1 is 5, and 4 is 9.

Or thus:

I multiply firſt the 7 by the 5, ſetting down the Product on a Slate, or a Piece of Paper, ſaying, 5 Times

7 is 35, and 2 I carried is 37 Shillings, or 1 *l.* 17 *s.* then I ſay 5 Times 10 is 50 Shillings, or 2 *l.* 10 *s.* and add this to 1 *l.* 17 *s.* it makes 4 *l.* 7 *s.* as before. See the next Example.

8. What coſt 7 Gallons, at £. 1 – 15 – 9¾ a Gallon?

7

£. 12 – 10 – 4¾ *Anſ.*

Here I ſay, 7 Farthings is 1 Penny, 3 Farthings; therefore, I ſet down ¾ and carry 1; then 7 Times 9 is 63, and 1 is 64 Pence, that is 5 *s.* 4 *d.* 4 and I carry 5; then 7 Times 5 is 35, and 5 is 40, 0 and I carry 4; 7 Times 1 is 7, and 4 is 11, that is, 110 Shillings in all, which is 5 *l.* 10 *s.* that is 10, and I carry 5; and *laſtly*, 7 Times 1 is 7, and 5 is 12.

Or thus, 7 Times 5 is 35, and 5 is 40 Shillings, that is 2 *l.* which I ſet down any where on a Slate; then I ſay, 7 Times 10 Shillings is 3 *l.* 10 *s.* Now 3 *l.* 10 *s.* and 2 *l.* is 5 *l.* 10 *s.* as before. Again,

9. What coſt 12 Quarters of Malt, at a Quarter } £. 1 – 14 – 6

12

Anſ. £. 20 – 14 –

Here I ſay 12 6 Pences is 6 Shillings, that is 0, and I carry 6; then 12 Times 4 is 48, and 6 is 54, 4, and I carry 5; 12 Times 1 is 12, and 5 is 17; that is 174 Shillings, which is 8 *l.* 14 *s.* that is 14, and I carry 8; then 12 Times 1 is 12, and 8 is 20 Pounds. Or,

By the ſecond Way, 12 6 Pences is 6 Shillings, as before, 0, and I carry 6; then 12 Times 4 is 48, and 6 is 54, that is 2 *l.* 14 *s.* then 12 Times 10 Shillings is 6 *l.* Now 6 *l.* and 2 *l.* 14 *s.* is 8 *l.* 14 *s.* as before, that is 14, and I carry 8; then 12 Times 1 is 12, and 8 is 20.

Tyro. I underſtand both the Ways very well.

Philo. Take which you think is eaſieſt, they both anſwer the ſame End.

Tyro. But ſuppoſe I have a larger Quantity than 12, how muſt I multiply the Price by that Number?

Philo. By the following Rule.

·3 *When there are* 2 *Figures to multiply by.*

Rule. When the given Quantity is more than 12, and contains any ſuch Number as can be found in the *Multiplication Table,* then find any 2 Numbers, which, when multiplied together, will make the given Number; and then multiply the given Price by any one of thoſe Figures, and that Product multiply by the other Number, and that Product is the Anſwer. Thus, ſuppoſe I am to multiply by 15, I find 3 Times 5 is 15; therefore, I multiply by the 3 firſt, and ſet down the Product; then I multiply this Product by 5, and that gives me the Anſwer for 15; becauſe 3 Times 5, or 5 Times 3 make that Number. Again, ſuppoſe I were to multiply by 24, I find 4 Times 6 is 24; therefore, I firſt multiply by 4, and then multiply that Product by 6; which is the Anſwer: Or otherwiſe, as 3 Times 8 is 24, I may therefore multiply firſt by 3, and then by 8. So if the Number be 63, I find 7 Times 9, or 9 Times 7 is 63; therefore, I multiply the Price by any one of theſe Figures, and that Product I multiply by the other for the true Anſwer.

10. What coſt 15 Ells of Holland, at £. – 7 – 6 an Ell? Here 3 Times 5 is 15, multiply firſt by 3

The Price of 3 Ells — —	£. 1	– 2	– 6	
Multiply by 5 — — —			5	
Price of 15 Ells — —	£. 5	– 12	– 6	*Anſ.*

Work at Length.

First I say 3 Six-pences is 1 *s.* 6 *d.* that is 6 and I carry 1; then 3 Times 7 is 21, and 1 I carried is 22 Shillings, which is 1 *l.* 2 *s.* So is the Price of 3 Ells 1 *l.* 2 *s.* 6 *d.* Now I multiply this 1 *l.* 2 *s.* 6 *d.* by 5 (because 5 Times 3 is 15) saying, 5 Times 6 is 30 Pence, is 2 *s.* 6 *d.* or 5 Six-pences is 2 *s.* 6 *d.* that is 6, and I carry 2; then 5 Times 2 is 10, and 2 is 12, which I set down. *Lastly,* I say, 5 Times 1 is 5; so the Answer for 15 Ells, at 7 *s.* 6 *d.* an Ell, is £. 5 12 – 6.

11. What cost 24 Chaldrons of Coals, at } £. 1 – 11 – 6 a Chaldron?

4 Times 6 is 24, first multiply by				4	
The Price of 4 Chald.		6 –	6 –	0	
6				6	
The Price of 24 Chald.	£.	37 –	16 –	0	*Ans.*
Proved another Way —	£.	1 –	11 –	0	as above.
3 Times 8 is 24, multiply by				3	
Price of 3 Chald.		4 –	14 –	6	as above.
Multiply by 8				8	
Price of 24 Chald.	£.	37 –	16 –	0	

12. What cost 35 Sheep, at £. 1 – 15 – 7 each?

5 Times 7 is 35, multiply first by				5	
Price of 5		8 –	17 –	11	
7				7	
Price of 35	£.	62 –	5 –	5	*Ans.*

13. What

13. What cost 84 Load, at £. 3 – 10 – 6 a Load?
6 Times 8 is 48, multiply by 6

Price of	6	21 – 3 – 0
Multiply by	8	8
Price of	48	£. 169 – 4 – 0

14. What cost 72 Pieces of Holland, at } £. 2 – 3 – 5 a Piece?
6 Times 12, or 12 Times 6 is 72, by 12

Price of	12	26 – 1 – 0
Multiply by	6	6
Price of	72	£. 156 – 6 – 0 *Ans.*

15. What cost 108 Quartern Loaves, at } £. 0 – 0 $5\frac{3}{4}$ a Piece?
12 Times 9 is 108, multiply by 12

Price of	12	0 – 5 – $9\frac{0}{0}$
	9	9
Price of	108	£. 2 – 11 – $9\frac{0}{0}$

Note 1. I have here indulged you with Cyphers, because I would do every Thing that is easy to your Understanding; but really *Tyro*, it is better without them. Set down now 5 Pence 3 Farthings any where.

$5\frac{3}{4}$
12

– 5 – 9
9

£. 2 – 11 – 9 *Answer.*

Note 2. This is the only Way, if you have a Mind to do Things quick, and off Hand; for tho' there be a Form in some Schools to the contrary, and you may hitherto have been instructed in that Way; yet, as I observed before, when you come to do a Sum, you are not bound to set it down in the very Form you were taught at School; for while you are doing *that*, another will answer the Question over and over.

Tyro. I understand you Sir, very well, and thank you for your Care; but it is only Use, as you observed; for I think one full as easy at the other, and I grant it is much better for the quick dispatching of Business.

16. What comes the Cloathing of 144 Soldiers to, at } £. 3 - 12 each Man?

12 Times 12 is 144, multiply by			12
12 cost		43 -	4
12	again by		12
144 cost		£. 518 -	8 *Ans.*

Tyro. You need not give me any more Examples: But pray, suppose the Quantity, or given Number, be such as does not fall under, or cannot be found in the *Multiplication-Table*, such as 17, 26, 38, 59, or the like; How then?

Philo. This is as easy as the other, as appears by the following Rule.

4. *Of Numbers that are not to be found in the* Multiplication-Table, *and how to work by them.*

Rule. When the given Number does not fall under the common Course of the Table, such as 17, 38, 59, or the like; then take any two Figures that will come the nearest to the Number (but not exceeding it) and work

work with them as in the former Examples, and then add the Price to to that Product as many Times as there are odd Numbers, and the Work is done.

We will give you Examples of 17, 38, and 59.

17. What cost 17 Gross of Corks, at £ - 10 - 6½ a Gross?
4 Times 4 is 16, and 1 is 17. Mult. by 4

Price of	4 is	2 - 2 - 2
	4	4
Price of	16 is	8 - 8 - 8
Add the Price of	1 Gross, *viz.*	10 - 6½
Price of	17 is	£. 8 - 19 - 2½ *Ans.*

18. What cost 38 Loads of Hay, at £. 1 - 11 - 6 a Load?
6 Times 6 is 36, and 2 is 38. Mult. by 6

Price of	6 is	9 - 9 -
	6 by	6
Price of	36 is	56 - 14 -
Mult. the Price 1*l.* 11 *s.* 6. by	2 gives	3 - 3 - add
Price of	38 is	£. 59 - 17 - *Ans.*

19. What is the Value of 59 Ports £. 1 - 16 - each
7 Times 8 is 56, and 3 is 59. Mult. by 7

Value of	7 is	12 - 12 -
	8 by	8
Value of	56 is	100 - 16 -
Then multiply 1*l.* 16 *s.* by	3 is	5 - 8 - add
Value of	59 is	£. 106 - 4 -

This may be done another Way.

As you ſaid before, 7 Times 8 is 56, and 3 added made 59: So now you may ſay, 6 Times 10 is 60; and then take, or ſubtract the Value of 1 Piece of that Product, and the Anſwer will be the ſame as 59.

1 Port is		£. 1 – 16 –
10 Times 6 is 60, firſt	by	6
Value of 6 is		10 – 16 –
10		10
Value of 60 is		108 – –
Subtract 1 Piece, *viz.*		1 – 16 – ſubtract
59	*Anſ.*	£. 106 – 4 – as above

Note 1. I have done this Sum 2 Ways for your Satisfaction; and you may in all ſuch like Caſes take which you like beſt: But as I obſerved before, it is better to take leſs, and then add the odd ones to that Sum, rather than to take more, and ſubtract from it.

Note 2. If you are perfect in what has already been ſhewn you, it will be very eaſy to perform any Sum in common Arithmetic, relating to Buſineſs, not only within the Compaſs of the Table, but in much larger Numbers. As for Inſtance; ſuppoſe it was required to tell the Value of 1000 Moidores: Or what will it coſt to cloath 1000 Men, at 1 *l.* 7 *s.* a Man? Here 10 Times 10 make 100, and 10 Times 100 makes 1000. Multiply therefore 1 *l.* 7 *s.* by 10; then that Product by 10; and this laſt Product by 10 will give the Anſwer, *viz.* £. 1350.

QUESTIONS

QUESTIONS *undone for Practice.*

1. What comes 33 Dozen of Candles to, at 4 *s.* 9 *d.* a Dozen? *Answer* £. 7 - 16 - 9. Multiply by 3, and then by 11.

2. How much is 46 Pistoles, at 17 *s.* 6 *d.* each? Or what cost 46 Pieces of *Irish*, at 17 *s.* 6 *d.* a Piece. *Answer* £. 40 - 5. Multiply by 5, then by 9, and add 17 *s.* 6 *d.* more for the odd 1.

3. What cost 63 Barrels, at £. 1 - 5 - 9 a Barrel? *Ans.* £. 81 - 2 - 3.

4. What comes 49 Months Salary to, at 3 Guineas a Month? *Ans.* £. 154 - 7.

5. What comes 105 Gallons of Rum to, at 7 *s.* 6*d.* $\frac{1}{2}$ a Gallon? *Ans* 39 - 11 - 10$\frac{1}{2}$. 10 Times 10 to make 100, and then multiply 7 *s.* 6 *d.* $\frac{1}{2}$ by 5, for the odd 5 Gallons, and add it to the last Product.

6. If I spend 1 *d.* $\frac{3}{4}$, or 7 Farthings a Day, how much is that a Year, allowing 365 Days? *Ans.* £. 2 - 13 2 $\frac{3}{4}$.

First, 10 Times 10 make 100; then multiply the Answer of 100 by 3, it gives you the Expences of 300 Days, *viz.* £. 2 - 3 - 9. Now there are but 65 Days behind; therefore set down 7 Farthings in another Place, and multiply it by 8, and that Product multiplied by 8 again makes 64, and then add once 1 *d.* $\frac{3}{4}$ for the odd Day, gives 9 *s.* 5 *d.* $\frac{3}{4}$ for the 65 Days, which added to the 300 Days, gives £. 2 - 13 - 2$\frac{3}{4}$. *Secondly*, Or thus, which is shorter, 11 Times 11 is 121; then multiply the Product of 121 by 3, gives 363, and then add 2 Times 1*d.* $\frac{3}{4}$, *viz.* 3*d.* $\frac{1}{2}$ to that Product, gives £. 2 - 13 - 2$\frac{3}{4}$, as before.

As I have added the Answers to these Questions, I hope, *Tyro*, you will try to prove the Answers at large: For if you mind and make yourself Master of this Rule, you will be able to cast up any common Thing as quick, or quicker, than by any other Method, and with far greater Ease.

As for *Cross Multiplication, viz.* multiplying Money by Money, or Feet and Inches by Feet and Inches, it is better let alone for the present; therefore, we will proceed to *Division.*

DIALOGUE V.

SECTION I.

Of DIVISION.

Tyro. WHAT is *Division*, and what does it teach?

Philo. Division is just the Reverse of *Multiplication*; for, as any Sum is encreased as many Times as the Figure you multiply by; so in *Division*, the Number is decreased, or divided into as many Parts, as the Value of the Figures you divide by.

Tyro. What is to be learned, or observed in this Rule?

Philo. There are four Things very necessary to be known in *Division*, *viz.*

First, The *Dividend*, which is the Sum given to be divided.

Secondly, The *Divisor*, or the Number you are to divide by.

Thirdly, The *Quotient*, or *Answer*, which shews you how many Times the *Divisor* is contained in the *Dividend*: Or into how many Parts the *Dividend* is divided.

Fourthly, The *Remainder*, which is a fractional Part of the *Quotient*: But this does not concern you as yet.

Tyro. Am I to get this by Heart?

Philo. You are not bound to get it just Word for Word; but you should understand well what the first 3 mean.

Tyro,

Tyro. Be so kind, Sir, as to explain them a little more for me.

Philo. Observe then: Let us take any two Numbers, suppose 24, and 6: Now 24 is the *Dividend*, and 6 is the *Divisor*. Then I ask how many Times 6 can I have in 24, and the Answer is 4; which 4 is called the *Quotient*. So also, suppose it was required to divide 108 by 12, or into 12 Parts, then every Part would be 9; for 12 Times 9 is 108. Now 108 is the *Dividend* or Sum to be divided; 12 is the *Divisor*, or what you divide by, and 8 is the *Quotient*.

Tyro. Now Sir, I apprehend you quite well.

Philo. Then I will proceed to some Examples in single Figures; but pray observe the following Rule.

1. *Of dividing by single Figures in one Line only.*

Rule. First, ask how many Times the *Divisor* is contained in the first Figure of the *Dividend*, and if the *Divisor* be larger than the first Figure in the *Dividend*, then seek how many Times you can have it in the first two Figures of the *Dividend*, and set the Figure down accordingly: And if any Thing remains from the first Figure in the *Dividend*, carry it to the second; and if any Thing remains in the second Figure, carry it to the third; remembering always in this short *Division*, that if one remains you call it 10, if 2 remains you call it 20, if 5 50, and so on; carrying the Remainder of one Figure to another in your Mind.

Note, To make the Work both shorter and easier, remember, that 2's is *Two's*, 3's is read *Three's*, 5's is *Five's*, 12's is *Twelves*, and so for any other Figure: Thus, the 7's in 14, is read thus, the *Sevens* in 14; and the 6's in 24, is the *Sixes* in 24; which is the same as if I should ask, how many *Sixes* can I have in 24, but only shorter and more convenient.

An Example or two will, with Care, make it familiar to you.

Ex.

Ex. 1. *Dividend*		Ex. 2. *Dividend*	
Divisor	3)39	*Divisor*	4)168
Quotient	13 *Ans.*	*Quotient*	42 *Ans.*
	3		4
Proof	39	*Proof*	168

Now observe: In *Ex.* 1, I ask how many *Three's* I can have in 3; or I say, the 3's in 3 is *once*; therefore I set down 1 under the 3 in the *Dividend*, and as there remains Nothing over, I ask how many 3's I can have in 9; or I say, the 3's in 9 is 3 Times 3, and Nothing over; therefore, I set down 3 under the 9, and it is done. Again,

In *Ex.* 2. I say the 4's in 1 I can't have; but taking the next Figure to it, *viz.* 6, I say the 4's in 16 is just 4 Times; therefore, I set down 4 under the 6 in the *Dividend*, and as there is Nothing remains, I only say, the 4's in 8 is twice, therefore I set down 2 under the 8, and it is done. Now to prove it, I multiply 42, the *Quotient*, by 4, the *Divisor*, and find it 168 like the *Dividend*.

Ex. 3 *Dividend*		Ex. 4. *Dividend*	
Divisor	8)37192	*Divisor*	9)245052
Answer	4649	*Answer*	27228
	8		9
Proof	37192	*Proof*	245052

Now observe, *Tyro*, in *Ex.* 3, I divide by 8, saying, the 8's in 3 I can't; but the 8's in 37 is 4 Times 8 is 32, and 5 over; I therefore set down 4 under the 7, and carry 5 to the next Figure, which is 1, which I now call

51; (for what you carry from one Figure you muſt always place before the next Figure) then I ſay the 8's in 51 is 6 Times 8 is 48, and 3 over; which 3 I now carry to the 9, and it is 39; therefore, I ſay the 8's in 39 is 4 Times 8 is 32, and 7 over; this 7 I now place before the 2, and it is 72; then I ſay the 8's in 72 is juſt 9 Times, and the Work is done. *To prove it*, I multiply the *Quotient* or *Anſwer* by the *Diviſor* 8, and find the *Product* the ſame as the *Dividend*. In *Ex*. 4, I ſay, the 9's in 2 I can't, but the 9's in 24 is 2 Times, or *twice* 9 is 18, and 6 over, which 2 I place under the 4, and carry 6 to the next Figure, which is 5, and call it 65; then I ſay the 9's in 65 is 7 Times 9 is 63, and 2 over, which 2 I place before the Cypher (0) and it is 20; then I ſay the 9's in 20 is twice 9 is 18, and 2 over, which I carry to the 5, and it is 25; then I ſay the 9's in 25 is twice 9 is 18, and 7 over, which I ſet before the laſt Figure 2, and it is 72; then I ſay the 9's in 72 is juſt 8 Times. *To prove it*, I multiply the *Anſwer* by 9, and the *Product* will be the ſame as the *Dividend*.

EXAMPLE 5.		EXAMPLE 6.	
Divide by	7)417296	*Divide by*	9)9471636
Anſwer	59613-5*	*Anſwer*	1052404
	7		9
Proof	417296	*Proof*	9471636

* Here in *Example* 5, there is 5 remains at laſt; therefore, I ſet it at the End of the Anſwer, parting it with a Stroke, thus, -5; and when I prove the Work I multiply by 7, and take the Remainder 5 in, ſaying, 7 Times 3 is 21, and 5 is 26, 6 and I carry 2, &c.

Ex-

EXAMPLE 7.		EXAMPLE 8.	
	8)716206		5)12631908
Answer	89525-6	*Answer*	2526381-3
	8		5
Proof	716206	*Proof*	12631908

More Examples for Practice.

7)697220716 9)407217943

Tyro. I understand what you have shewn me very well; but pray, before you come to long *Division*, give me an Example at large to divide by *Twelve* the short Way.

Philo. I will: Let it be required to divide 1479908 by 12: I set it down thus:

EXAMPLE 11.	EXAMPLE 12.
12)1479908	12)59904965
123325-8	4992080-5

Here I divide by 12, saying, the 12's in in 14 is *once* 12, and 2 over, and this 2 I carry to the 7 and it is 27; then I say the 12's in 27 is *twice* 12 is 24, and 3 over, that is 39; then I say the 12's in 39 is 3 Times 12 is 36, and 3 over, that is 39 again; therefore, I set down another 3, and carry the 3 that is over to the next Figure, which is a Cypher, calling it 30; then I say the 12's in 30 is *twice* 12 is 24 and 6 over, which is 68; now the 12's in 68 is 5 Times 12 is 60, and 8 over, which I place after the Sum, thus, -8, and it is done.

In *Ex.* 12. I say the 12's in 5 I can't; but the 12's in 59 is 4 Times 12 is 48, and 11 over, which 11 carried to, or joined to the next Figure 9 is 119; then I say the 12's in

119

119 is 9 Times 12 is 108, and 11 over again, which I now carry to, and join to the next Figure 0, and call it 110; then ſay the 12's in 110 is 9 Times, and 2 over, which 2 I join to, or carry to the 4, and it is 24: Now the 12's in 24 is juſt *twice*, and Nothing over; therefore I now begin a-freſh at the 9, ſaying, the 12's in 9 I can't, but the 12's in 96 is juſt 8 Times: *Laſtly*, I ſay, the 12's in 5 I can't have; therefore I ſet down a Cypher under the laſt Figure 5, and drawing a ſhort Line, ſet the 5 that remains after it, thus, –5.

Now, *to prove it*, I multiply back by 12, and take in the 5, ſaying, 12 Times 0 is 0, but 5 is 5; then 12 Times 8 is 96, 6 and I carry 9, *&c.* till I go through the Whole.

☞ *Note*, *Multiplication* is an infallible Proof for *Diviſion*; for if you multiply the *Quotient* by the *Diviſor*, you will have the ſame Figures as are in the *Dividend*; but always remember to take in the Remainder with the firſt Figure you begin to multiply by.

Tyro. I humbly thank you, Sir; I am quite ſatisfied with what you have ſhewn me; and now, if you pleaſe, I ſhall be obliged to you to ſhew me how to divide by ſeveral Figures.

Philo. You will ſoon learn it with Care: You muſt note there are 3 or 4 Ways to work *Diviſion*; but as my Intent is not for Curioſity, but Improvement, I ſhall only ſhew you that Method which is moſt *natural* and *practicable*; you may at any Time learn the reſt.

2. *Of dividing by* 2, 3, *or more Figures*.

Rule. Firſt *ſeek*, or aſk how many Times the Figures in the *Diviſor* are contained in the ſame Number of Figures in the *Dividend*, and put that Figure in the *Quotient*. *Secondly*, *Multiply* now the *Diviſor* by the ſaid Figure in the *Quotient*, and place it under thoſe Figures in the *Dividend* that you began to work with, always obſerving, that the *Product* be not larger than the Figures

gures in the *Dividend*; for if they are, you must rub out, or cancel the Figure in the *Quotient*, and put one of a less Denomination. *Thirdly*, This being done, *subtract* now the *Product* from that Part of the *Dividend* it stands under, and to the Remainder bring down the next Figure in the *Dividend*, placing, or joining it to the last Figure of the *Remainder*. Then *seek* how many Times the *Divisor* is contained in these Figures; then multiply the *Divisor* by the said Figure; then *subtract* again; and *lastly*, bring down the next Figure in the *Dividend*, as before; and thus proceed till you have no more Figures in the *Dividend* to bring down, and the Work is done.

☞ *Note* 1. Every Time you *subtract*, observe whether the *Remainder* be larger than the *Divisor*; for if it be, you must put a larger Figure in the *Quotient*.

Note 2. Whenever you take a Figure down from the *Dividend*, and join it to the *Remainder*, and that is still less than the *Divisor*; then always put a Cypher in the *Quotient*, and bring down another Figure of the *Dividend*. An Example or two at large will make it easier.

EXAMPLE I.

```
              Dividend
Divisor  15)19260(1284  Quotient
            15          or Answer
            ---                   Quotient    1284
             42                   multiply by   15  Divisor
             30                               ----
             ---                              6420
             126                              1284
             120                              -----
             ---                  Product    19260  Dividend
               60
               60
               --
                0
```

Now

Now observe: Having 2 Figures in the *Divisor*, I ask how many Times they are contained in the 2 first Figures of the *Dividend*, (*viz.* 19) and find it *once*; therefore I set 1 in the *Quotient*. *Secondly*, I multiply the *Divisor* 15 by 1, saying, *once* 5 is 5, *once* 1 is 1, and place it under the 19. Then, *Thirdly*, *Subtract* 15 from 19, and there remains 4; and *lastly*, I bring down the next Figure in the *Dividend* (*viz.* the 2) and join it by the Side of the *Remainder* 4, and it is 42; and now I begin as at the first, and ask how many Times 15 are contained in 42, and find it *twice*; therefore, I set down 2 in the *Quotient*: Then I multiply the *Divisor* 15 by 2, which is 30, and place it under 42; this done, I *subtract* 30 from 42, and there remains 12; and then again, I bring down the next Figure of the *Dividend* (*viz.* 6) and place it by the Side of 12, and it is 126. Then I ask how many Times 15 I can have in 126, and find it 8 Times; therefore, I put an 8 in the *Quotient*, and multiply 15 by it, which is 120, which I place under 126. Then I *subtract* 120 from 126, which is 6, and bring down the last Figure in the *Dividend*, which is a Cypher (0) and it makes 60; then I seek how many Times 15 I can have in 60, and find it 4 Times; then I multiply 15 by 4, and find it just 60, which I place under the other 60, and the Work is done.

RULE 2.

Note 1. When there are several Figures in the *Divisor*, it is easier for a Learner to ask how many Times the first Figure of the *Divisor* is contained in the first Figure of the *Dividend*, and place the Times in the *Quotient*; then multiply the whole *Divisor* by the *Quotient* Figure, and if the Product be more than the Figures which belong to the *Dividend*, you must make Trial of a less Figure, and put it in the *Quotient*.

Note

Note 2. If the first Figure of the *Divisor* be larger than the first Figure in the *Dividend*, then take 2 Figures in the *Dividend*, and seek how many Times the first Figure of the *Divisor* is contained in them.

Note 3. You must remember, that in making Trial how often the first Figure in the *Divisor* is contained in two Figures of the *Dividend*, it will sometimes appear to be 10, or 12 Times; but observe, it never can be above 9 at most, and oftentimes not so many as it appears to be.

The same Example further demonstrated.

Let it be required to divide 19260 by 15?

First, I set the *Dividend* down on a Slate, and make a Couple of crooked Lines at the Ends of it, in the first of which I place the *Divisor*, thus, 15)19260(and the other is to place the *Quotient* in.

Secondly, I ask how many Times the first Figure of the *Divisor* is contained in the first Figure of the *Dividend*, and find it *once*, therefore, I place a 1 in the *Quotient*, and multiply the whole *Divisor* by it, and place the Product under the two first Figures of the *Dividend*, and subtract it therefrom, and it will stand thus:

Second Work.

15)19260(1
15
Remains 42

Thirdly, To this Remainder 4 I bring down the next Figure, *viz*. 2, (always making a Dot under the Figure I bring down) and it is 42; then I ask how often the first Figure 1 in the *Divisor* is contained in 4, and it is 4 Times; but upon Trial I find 4 Times 15 is 60, there-

therefore, as 60 is more than 42, I must take a less Figure; I therefore make Trial of a 2, and find twice 15 is 30; which I place under 42, and subtract it, and there remains 12, which stands thus:

Third Work.

```
         15) 19260 (12
             15··
             ————
              42
              30
             ————
Remains      126
```

Fourthly, I now make a Dot under the 6, and bring it down by the Side of the 12, and it is 126; then I ask how many of the first Figures of the *Divisor* I can have in the first two Figures of the *Dividend*, and find it 12 Times; but according to *Note* 3, it never goes above 9 Times; therefore, I multiply 15 by 9, and it is 135: Now I can't take 135 out of 126, therefore 9 Times is too much, and I make Trial of a less Figure, to wit, 8, which I put in the *Quotient*, and multiply 15 by it, which is 120, and place it under 126, and there remains 6, which stands thus:

Fourth Work.

```
         15) 19260 (128
             15···
             ————
              42
              30
             ————
              126
              120
             ————
Remains        6
```

Lastly,

Lastly, I make a Dot under the Cypher (0) and bring it down by the Side of the 6, thus, 60; then I ask how many Times the first Figure of the *Divisor* is contained in 0, or the *Ones* in 6 is 6 Times; but upon Trial, I find it will go but 4 Times; therefore, I place a 4 in the *Quotient*, and multiplying 15 by it, find it to be 60, which I place under the other 60, and there remains 0, and the Work is done, as under.

Last Work.

```
Divisor 15) 19260 (1284 Quotient
            15...                  Proof
            ----                   1284 Quotient
             42                      15 Divisor
             30                    ----
             ---                   6420
             126                   1284
             120                   -----
             ---           Product 19260 Dividend
              60
              60
              --
               0
```

☞ *Note,* The Reason of making Dots under every Figure you take down, is because you may not mistake which Figure comes next in Course; but when you are quite perfect you need not trouble yourself with them.

Tyro. This is a plain Demonstration, and I see now the Manner of working *Division*, though, I own, I am not perfect yet.

Philo. I shall give you an Example or two more then, and shew you at the same Time how to prove it by *Addition*.

Ex-

EXAMPLE 2.

```
Divide by 375)24172196(64459 Ans.
             *2250....
             ------
               1672
              *1500
              ------
                1721
               *1500
               ------
                 2219
                *1875
                ------
                  3416
                 *3375
                 ------
Remains             *71
                 ------
Proof        24172196
```

```
      64459
        375
   --------
     322295
    451213
   193377
   --------
   24172125
         71 add Rem.
   --------
   24172196 Proof.
```

The PROOF.

This Example is proved the ſame as the laſt, by multiplying the *Quotient* by the *Diviſor*, and afterwards adding the *Remainder* to it, or elſe taking it in as you multiply.

PROOF *by* ADDITION.

Though *Multiplication* be an infallible Proof of *Diviſion*, yet in large Sums, *Addition* is much ſhorter and eaſier, and when the Work is right, is as infallible as the other. If indeed it be objected, that a Boy may *vamp*, or alter the Figures (as in proving *Multiplication* by the Croſs) in order to make the Sum come right, there is the ſame Reaſon to ſuppoſe (without his Maſter's Inſpection) that he may alter his *Multiplication* Sum, when he comes to add it up, that it may fall right with the *Divi-*

Dividend. Besides, as in the very Work of every *Division* Sum, the *Divisor* is naturally multiplied into every Figure of the *Quotient*, what need it to be done again? And I persuade myself, that those Masters that have made Use of this Method of proving *Division*, will acknowledge, that it is not only much easier to the Scholar, but also much more improving; because he must set his Figures in Order, right under one another, or else he will be puzzled to add the Sum up: He cannot therefore avoid improving himself (in some Measure) by this Method.

To prove Division *by* Addition.

Rule. Add the Remainder of all the different Products of the *Divisor* together, in Order, as they stand, and their Sum will be the same as the *Dividend*. Or thus: Add the Remainder (if any) and all the lower Lines together in Order, as they stand, and you will find their Sum the same as the *Dividend*, if the Work be right.

Note, In *Example* 2, I have made Stars (thus *) against those Figures which are to be added together; which you see is the lower Row of the two; for the Top Row is never added.

Two

Two Examples, with their Proofs.

EXAMPLE 3.

Divide by 5267) 821695074 (15008 *Anſ.*
*5267....

29499
*26335

31645
*31602

43074
*42136

Remains *938

Proof 821695074

EXAMPLE 4.

Divide by 9758) 94076257 (9640 *Anſ.*
*87822..

62542
*58548

39945
*39032

Remains *9137

Proof 94076257

Here in the first Example, I take all the lower Lines of the two, against which this Mark (*) is placed, and beginning at the Remainder, I ſay 8 and 6 is 14, 4 and I carry

I carry 1, to 3 is 4, and 3 is 7; then 9 and 1 is 10, that is 0, and I carry 1, to 2 is 3, and 2 is 5; then 4 and 5 is 9, then 6 and 3 is 9, and 7 is 16, 6, and I carry 1, to 1 is 2, and 3 is 5, and 6 is 11, that is 1, and I carry 1, to 3 is 4, and 6 is 10, and 2 is 12, that is 2, and I carry 1, to 2 is 3, and 5 is 8. And thus you may proceed to prove the other Example.

Tyro. I confeſs I could not have thought it had been ſo eaſy; and it is (in Effect) proving of it by *Multiplication*, as you obſerved.

Philo. I am glad you underſtand it; and I hope you will take ſuch Care as to have no Occaſion to prove the Work at all. Perſons in Buſineſs, *Tyro*, cannot go thro' theſe Forms; if they ſuſpect they have done wrong, they look over the Work a ſecond Time, and that is a ſufficient Proof in general.

Of CONTRACTIONS.

Tyro. What is the Uſe of *Contractions?*

Philo. When the *Diviſor* conſiſts of ſeveral Cyphers after a Figure, or Figures, then cut them all off, or ſeparate them from the Figures with a Daſh of your Pen or Pencil; and alſo remember at the ſame Time to cut off as many Cyphers, or Figures in the *Dividend*; then work ths Sum as if ſuch Cyphers never had been there at all, and you will have the ſame Anſwer.

Ex. 1.	Ex. 2.	Ex. 3.
1|000)9250|000	4|00)547|600	12|00)54762|00
9253 *Anſ.*	1369 *Anſ.*	*Anſ.* 4563—6

Here I cut off all the Cyphers in the *Diviſor*, and as many Cyphers in the *Dividend*, and divide only by the ſingle Figures, and if any Thing remains, I ſet it after it. As in *Example* 3, there is 6 remains, which I ſet after the Anſwer, thus,—6.

Tyro.

Tyro. This is easy enough; and now, if you please, I shall be glad to know what you mean by *Division of Parts.*

SECTION II.

DIVISION *of Parts.*

Philo. DIVISION *of Parts* is the dividing by any two single Figures in their Parts, which 2 Figures multiplied together will be equal to the *Divisor.*

Tyro. I do not rightly apprehend you.

Philo. You remember, *Tyro,* in *Questions* of *Multiplication,* that when any Number was given in the Table, you found two such Figures, which, when multiplied together, would make that Number; so here also you do the same, only with this Difference, that you here divide by them instead of multiplying. Thus, suppose I was to divide by 24, by 32, by 48, or by 72, I first divide by 3, then by 8; for 3 Times 8 is 24, and the last Quotient is the Answer. So if I divide by 48, I divide the Number first by 8, and then that *Quotient* I divide by 6, and have the proper Answer, *&c.*

EXAMPLE I.

Divide 16488 *by* 24. Here 6 Times 4 is 24.

First by 6) 2748 *Quotient by* 6

Then by 4) 687 *Quotient by* 24

EXAMPLE 2.

Divide	126216 *by* 72.	6 Times 12 is 72.
First by 6)	21036 *Quotient by* 6	
Then by 12)	1753 *Quotient by* 72	

Tyro. I understand you; this is only then the Reverse of *Multiplication.*

Philo. Nothing more, as you may more plainly see by what follows.

2. *Of dividing* MONEY.

Division of Money is just the Reverse of *Multiplication of Money*; for as in *Questions* of *Multiplication*, the Money is encreased so many Times, according to the given Number; so here the Money is decreased, or divided into as many Parts as the given Number is.

It will be easier to your Comprehension to take an Example in *Multiplication*, and prove it by *Division.*

If 1 Ell cost £. 1 – 3 – 8 What cost 40 Ells?

		8
8	9 – 9 – 5	
5		5
40	£. 47 – 6 – 8	*Ans.*

PROOF *by* DIVISION.

1 If 40 Ells cost £. 47 – 6 – 8, what cost 1 Ell?

Here I divide back by the same Figures I multiplied by, carrying the Pounds to the Shillings, and the Remainder of the Shillings to the Pence, doing by *Twenties*, and by *Twelves*, as in *Addition.*

by

by 5) £. 47 – 6 – 8

Then by 8) 9 – 9 – 4 Price of 8

£. 1 – 3 – 8 Price of 1 *Anʃ.*

Here I divide firſt by 5, ſaying, the 5's in 47 is 9 Times 5, and 2 over, which is £. 2; this £. 2 I carry to the 6 *s.* and it is £ 2 – 6, or 46 *s.* then I ſay the 5's in 46 is 9 Times 5 is 45, and 1 over, that is 1 Shilling, which I carry to the 8 Pence, and it is 1 *s.* 8 *d.* or 20 Pence, then I ſay the 5's in 20 is 4 Pence. Now I divide this £. 9 – 9 – 4 by 8, ſaying, the 8's in 9 is *once*, and £. 1 over, which I carry to the 9 Shillings, and it is £. 1 – 9, or 29 Shillings; then I ſay, the 8's in 29 is 3 Times 8 is 24, and 5 Shillings over, which I carry to the Pence, and it is 5 *s.* 4 *d.* or 64 Pence; then I ſay the 8's in 64 is 8 Times. So is the Price of 1 Ell £. 1 – 3 – 8; as appears alſo by the Work of *Multiplication.*

EXAMPLE 2.

Suppoſe £. 88 – 4 – 0 be divided among 56 poor Widows, how much is the Share of each?

by 7) £. 88 – 4 – 0 Here 7 Times 8 is 56.

by 8) 12 – 12 – 0 Share of 8

Anʃ. 1 – 11 – 6 Share of each.

If you underſtand the Nature of multiplying any Sum by any Figure, you ſee you may as readily divide it back again.

Tyro. Sir, I ſee the Way of working it very plainly. Have you any Thing farther to add.

Philo. Nothing more, as you ſay you are perfect; only ſome Queſtions for to exerciſe you.

3. QUESTIONS *to exercise* DIVISION.

1. Divide 822306485 by 1715. *Anſ.* 479479.
2. Divide 150348045 by 285. *Anſ.* 527537.
3. Divide 47198714 by 6357. *Anſ.* 7424, and 4346 remains.

QUESTIONS *in* MONEY.

1. Divide 1 *l.* 16 *s.* 8 *d.* into 5 Parts. *Anſ.* 7 *s.* 4 *d.*
2. Divide 4 *l.* 8 *s.* 1 *d.* $\frac{1}{2}$ into 9 Parts. *Anſ.* 9 *s.* 9 *d.* $\frac{1}{2}$.
3. Divide 25 *l.* 5 *s.* 4 *d.* into 32 Parts, *Anſ.* 15 *s.* 9 *d* $\frac{1}{2}$.
4. A Gentleman left by Will 100 Pounds among 3 Score (or 60) poor Perſons, to be paid every *Chriſtmas-Day*; how much is each to receive?

I leave this laſt Queſtion wholly for the Learner to do. And now, *Tyro*, you are come to that Rule, in which you will exerciſe all the other *Four*; therefore, if you be not perfect, you will be at a Loſs very often.

DIALOGUE VI.

SECTION I.

Of REDUCTION.

Tyro. WHAT is *Reduction*, and what does it teach?

Philo. Reduction is a Rule compounded of all the foregoing Rules; being a proper Exerciſe for the better perfecting you in them. It teaches to *reduce* Things of one Denomination into another, and is of excellent Uſe in common Affairs of Life.

Tyro.

Tyro. How many Parts is this Rule divided into ?

Philo. Two. 1. *Reduction ascending.* 2. *Reduction descending.*

Tyro. What do you mean by *Reduction ascending.*

Philo. *Reduction ascending* is when Things of a *small* are *reduced*, or *brought* into Things of a *greater* Denomination ; as Farthings into Pence, Pence into Shillings, Shillings into Pounds, or Ounces into Hundred Weights : And *this* remember is done by *Division* only, by dividing by as many of the *less*, as make one of the *greater* Denomination.

Tyro. What do you mean by *Reduction descending ?*

Philo. *Descending* is just the Reverse of the other ; for by *Reduction descending*, Things of a *great* are *reduced* or *brought* into Things of a *less* Denomination ; as Pounds into Shillings, Shillings into Pence or Farthings ; *Cwts.* into Pounds, Tons into Quarters, Miles into Yards, Yards into Inches, and the like ; and *this* remember is always done by *Multiplication* only, by multiplying the *greater* Denomination by as many as it contains of the *less* Denomination.

Tyro. Then I find *Reduction descending* is the easier of the two, as it is performed by *Multiplication* only.

Philo. It is so : And that is the Reason it is commonly taught first.

Note, I shall prove every Sum of *Reduction descending* by *Reduction ascending*, and then you will see the Nature of both.

1. *Of* REDUCTION descending.

Tyro. How do you say this is performed ?

Philo. By this Rule. *Multiply every Denomination by as many as the next less Denomination contains, and you have the Answer, which is called* Reduction descending. Then to prove the Work, *divide back by the same Figures you multiplied by, and this is called* ascending.

A few Questions will make it plain to you.

Quest. 1. In 12 Pounds how many Shillings?

£. 12
Multiply by 20 Shillings in a £.

Ans. 240 Shillings.

PROOF *ascending*.

In 240 Shillings how many £. *Sterling?*
Here I divide back by 20, as before I multiplied.

2|0)24|0 Shillings.

£. 12 *Ans.*

Here I cut off the Cyphers in the *Divisor* and *Dividend* with a Dash of my Pen, and divide by 2 only, and the Answer is 12.

Quest. 2. In £. 23 - 14 *s.* how many Shillings and Pence.

£. 23 - 14
First by 20 and take in the 14.

474 Shillings.
Then by 12

5688 Pence.

PROOF.

In 5688 Pence how many Shillings and £.'s *Sterling?*
Divide by 12) 5688 Pence

Then by 2|0)47|4 Shillings

£. 23 - 14 as above.

Here

Here I divide by 12, and it brings the Pence into Shillings; then I divide by 20, cutting off the Cypher, and cutting off the 4 alſo: Then I divide by 2 only, ſaying, the 2's in 4 is *twice*, the 2's in 7 is 3 Times 2 and 1 over, which 1 I place before the Figure 4, that I alſo cut off, and it is 14 Shillings.

This is a *general Rule*; obſerve, that when you cut off any Figure, or Figures, what remains in dividing muſt be placed before them, and is the true Remainder.

Tyro. This is very plain I own.

Philo. Then we will proceed to *Queſtion* 3.

Queſt. 3. In £. 45 – 17 – 6¾ how many Shillings, Pence, and Farthings?

	£. 45 – 17 – 6¾
by	20
	917 Shillings
by	12
	11010 Pence
by	4
Anſ.	44043 Farthings

Here I multiply £. 45 by 20, and take in the 17 Shillings, ſaying, 0 is 0 but 7 is 7; then twice 5 is 10, and the 1 by the Side of the 7 Shillings is 11, that is 1, and I carry 1; then twice 4 is 8, and 1 is 9, which is 917 Shillings. Again, I multiply the Shillings by 12, and take in the odd Six-pence; and *laſtly*, I multiply the Pence by 4, and take in the odd 3 Farthings, ſo is the Work done.

PROOF *by* Reduction ascending.

In 4403 Farthings, how many Pence, Shillings, and Pounds *Sterling* ?

Here I divide only back by the same Figures I multiplied by, and it is done.

Divide by 4)44043 Farthings

by 12)11010 Pence, and the Farthings over

by 2|0) 91|7 Shillings, and 6 Pence over.

£. 45 – 17 – $6\frac{3}{4}$ as above.

Tyro. I understand it very well indeed.

Philo. Then I need not instruct you any more till some Difficulty offers.

Quest. 4. In £. 99 – 19 – 11 $\frac{3}{4}$, how many Shillings, Pence, and Farthings ?

£. 99 – 19 – 11 $\frac{3}{4}$
Multiply by 20

1999 Shillings
by 12

23999 Pence
by 4

95999 Farthings

In

In 95909 Farthings, how many Pence, Shillings, and Pounds?

Divide by 4)95999 Farthings

by 12)23999—3

by 2|0) 199|9—11

£ 99-19-11¾

5. In 30 Guineas, how many Shillings and Pence?

30 Guineas
21 Shillings make 1 Guinea

30
60

12

7560 Pence

PROOF.

In 7560 Pence, how many Shillings and Guineas?
12)7560 Pence

21)630(30 Shillings *Ans.*
63

00

And thus you see, *Tyro*, that any Sum, of any Name or Denomination, may be reduced to another.

Quest. 6. In £. 472 - 15 Shillings, how many Crowns, Shillings, Groats, and Pence?

£. 472 - 15
Multiply by 4 the Crowns in a £. and count the 15 *s.* for 3 Crowns, saying, 4 Times 2 is 8, and 3 is 11.

Crowns 1891
5 Shillings 1 Crown

Shillings 9455
3 Groats 1 Shilling

Groats 28365
4 Pence is 1 Groat

Pence 113460 *Anʃ.*

PROOF.

In 113460 Pence, how many Groats, Shillings, and Pounds?

Divide by 4) 113460 Pence

by 3) 28365 Groats

by 5) 9455 Shillings

by 4) 1891 Crowns

£. 472—3 Crowns over, *viz.* 15 Shillings, as above.

Note 1. To bring Pounds into Pence at one Operation, *multiply by* 240, becauʃe 240 Pence make 1 Pound.

To bring Pounds into Farthings at one Operation, *multiply* by 960, the Farthings in a Pound. On the contrary,

Note

Note 2. To bring Pence into Pounds, *divide* by 240. To bring Farthings into Pounds, *divide* by 960.

AVOIRDUPOIS-WEIGHT.

Quest. 7. In 17 *C.* 3 *qrs.* 15 *lbs.* how many *Cwt.* *qrs.* and *lbs.*

```
      C.  qr.  lb.
      17 - 3 - 15
by     4 qrs. make 1 Cwt.
    ------
      71 qrs.
by    28 lb. 1 qr
    ------
     573
    143
    ------
    2003 lbs. Ans.
```

Here I multiply by 4, and take in the odd 3 Quarters; then I multiply by 28, and take in the odd 15 Pounds, and the Work is done.

PROOF.

In 2003 Pounds Weight, how many Quarters of Hundreds, and Hundred Weight?

```
28)2003(71 qrs.        qrs.   lb.
   196               4)71  -  15
   ----              -------------
    43               17 - 3 - 15 as before
    28               C.   qr.  lb.
   ----
    15 lb. over
```

Quest.

Quest. 8. In 17 *C.* 3 *qrs.* 15 *lb.* how many *qrs. lbs.* and *oz.*

C.	*qrs.*	*lb.*
17 –	3 –	15
by 4		
71 *qrs.*		
28		
573		
143		
2003 *lb.* *		
16		
12018		
2003		
32048 *oz. Ans.*		

Note, The following Method is very useful in many Cases to reduce Hundred Weights into Pounds, being both short and expeditious, *viz.*

* Set down the Hundreds 4 Times under one another in the following Manner, and add the odd Pounds besides, gives the Answer.

17 *Cwt.*
17
17
17
99 *lb.* in 3 *qrs.* 15 *lb.*

2003 *lb.* *

* See a shorter Way than either of these in Ex. 1. of *Tare* and *Tret.*

PROOF.

In 32048 Ounces, how many *lbs. qrs.* and *Cwt.*

Divide this back again by 16, 28, and 4, and you will have 17 *C.* 3 *qrs.* 15 *lb.*

TROY-

TROY-WEIGHT.

Quest. 9. In 5 *lb.* 2 *oz.* 14 *dwts.* of Silver, how many *oz. dwts.* and *grs.*

	lb. oz. dwts.
	5 — 2 — 14
12 *oz.* 1 *lb. Troy by*	12 and take in 2 *oz.*
	62 *ozs.*
20 *dwts.* 1 *oz.* by	20 and take in 14 *dwts.*
	1254 *dwts.*
24 *grs.* 1 *dwt.* by	24
	5016
	2508
	30096 Grains *Ans.*

PROOF.

Divide back by the ſame Figures, 24, 20, and 12, and have a Regard to the Remainder, you'll find it 5 *lb.* 2 *oz.* 14 *dwts.* Do you now underſtand what has been ſhewn you?

Tyro. I do very well; and I can ſee that *Reduction aſcending* is only the Proof to the other, and that they prove one another in every Reſpect.

Philo. If you are perfect in what I have ſhewn you, there is no Occaſion to run through all the Weights and Meaſures, for they are done after the ſame Manner.

Tyro. I know it, Sir; but every Example is a freſh Encouragement.

Philo. True; and I am as ready to give them.

DRY-

DRY-MEASURE.

Quest. 10. In 14 Loads, 15 Bushels, how many Bushels and Pecks.

L. *B.*
14 – 15
40 Bushels 1 Load, *mult.* *by* 40 and take in the 15 Bush.

575
4 Pecks 1 Bushel

2300 Pecks *Ans.*

PROOF.

In 2300 Pecks, how many Bushels and Loads?
Divide 2300 by 4, and that Quotient divide by 40, and 15 will remain; which is 14 Loads, 15 Bushels.

LIQUID-MEASURE.

Quest. 11. In 12 Hogsheads of Wine how many Gallons and Pints?

12 Hogsheads
by 63 Gallons in 1 Hogshead of Wine.

36
72

756 Gallons
by 8 Pints 1 Gallon.

6048 Pints *Ans.*

PROOF.

In 9048 Pints how many Gallons and Hogsheads ;
Divide this back again by 8, and 63, and you will have just 12 Hogsheads.

BEER-MEASURE.

Quest. 12. In 18 Butts of Beer how many Hogsheads and Gallons ?

18 Butts
by 2 Hogsheads 1 Butt.

36 Hhds.
by 54 Gallons 1 Hogshead of Beer.

144
180

1944 Gallons *Ans.*

PROOF.

In 1944 Gallons of Beer, how many Hogsheads and Butts ? *Ans.* 18 Butts.

CLOTH-MEASURE.

Quest. 13. In 26 Yards, 3 Quarters, how many Quarters and Nails ?

Yards. qrs.
26 – 3
by 4 Quarters 1 Yard, and take in the 3 *qrs.*

107 *qrs.*
by 4 Nails 1 *qr.*

428 Nails.

PROOF.

PROOF.

In 428 Nails, how many Quarters and Yards?
Divide 428 by 4, and then by 4 again. *Ans.* 26 Yards, 3 qrs.

Note, This, and the two following Questions, are of great Service in the *Rule of Three direct*; where it is often required to reduce Yards and Ells into Quarters, and the contrary.

Quest. 14. In 26 Ells *English*, 3 Quarters, how many Quarters and Nails?

	Ells qrs.
	26 – 3
by 5, and take in 3 qrs.	5 qrs. 1 Ell *English*.
	133 qrs.
	by 4 Nails 1 qr.
	532 Nails

PROOF.

In 532 Nails, how many Quarters and Ells *English*?
Divide 532 by 4, and by 5, you'll have 26 Ells *English*, 3 qrs.

Quest. 15. In 26 Ells *Flemish*, 2 Quarters, how many Quarters and Nails?

Ells Fl. qrs.
26 – 2
by 3 qrs. 1 Ell *Flemish*, take in 2 qrs.

80 qrs.
by 4 Nails 1 qr.

320 Nails *Ans.*

PROOF.

PROOF.

In 323 Nails, how many Quarters, and Ells *Flemish*?
Divide 320 by 4, and by 3, you'll have 26 Ells *Flemish*, 2 qrs.

LONG-MEASURE.

Quest. 16. In 927 Miles, how many Yards, Feet and Inches?

```
                  927 Miles
In 1 Mile are    1760 Yards
                 -----
                55620
               6489
               927
               -------
              1631520 Yards
                    3 Feet 1 Yard
              -------
              4894560 Feet
                   12
              --------
             58734720 Inches
```

PROOF.

In 58734720 Inches, how many Feet, Yards, and Miles?
Divide back by the same Figures, you'll have at last 927 Miles.

Note, I shall give you a fuller Example in this Rule, when we come to *Compound Reduction*, there being *Division* required when you are to bring Rods into Yards.

LAND-

LAND-MEASURE.

Quest. 17. In 54 Acres, how many Roods and Poles?

4 Roods 1 Acre, *by* 54 Acres.
4 or multiply 54 by 160, the Rods in an Acre, gives 8640 Rods.

216

40 Rods 1 Rood *by* 40

Rods 8640

PROOF.

In 8640 Rods or Poles, how many Acres?

Divide by 40, and then by 4, or divide 8640 by 160, and it gives 54 Acres.

SQUARE-MEASURE.

Quest. 18. In 217 Square Yards, 5 Feet, how many Square Feet, Inches, and Square Quarters?

Square Yards Feet
217 – 5

9 Square Feet 1 Yard, *by* 9

1958 Square Feet

144 Inches 1 Foot 144

7832
7832
1958

281952 Square Inches

16 Square qrs. 1 Inch 16

1691712
681952

4511232 Square Quarters.

PROOF.

PROOF.

In 4511232 Square Quarters, how many Square Inches, Feet, and Square Yards?

Divide this Number back by 16, you have Square Inches; then by 144, you have Square Feet, and *lastly*, by 9, you'll have 217 Yards, 5 Feet.

Note, That 12 Times 144, or 1728 ſolid Inches, make a *ſolid Foot*; ſo that you are to multiply *ſolid Feet* by 1728, to bring them into *ſolid Inches*, and on the contrary, to bring ſolid Inches into *ſolid Feet*, you muſt *divide* by 1728.

TIME.

Queſt. 19. How many Days, Hours, Minutes, and Seconds are expired ſince the Birth of our Lord and Saviour, *Jeſus Chriſt*, ſuppoſing it 1752 Years, 217 Days, 17 Hours, and 35 Minutes, and allowing juſt 365 Days to a Year.

	Years	*Days Hours Min.*
	1752	– 217 – 17 – 35
Days in a Year *by*	365	take in 217, ſaying, 5 Times 2 is 10, and 7 is 17, &c. in the next 2 Figures.
	8767	
	10513	
	5258	
	639697	Days
by	24	and take in 17 Hours.
	2558795	
	1279395	
	15352745	Hours
by	60	and take in 35 Min.
	921164735	Minutes
	60	
Anſ.	55269884100	Seconds, or Moments

PROOF.

PROOF.

In 55269884100 Seconds, how many Minutes, Hours, Days, and Years?

Divide this by 60, 60, 24, and 365, and you will find 1752 Years, 217 Days, 17 Hours, 35 Minutes.

☞ *Note*, According to your Tables in Time, 365 Days 6 Hours make a Year; therefore, as many Years as is given, you must multiply them by 6, and add them to the Hours.

Quest. 20. If a Lad be just 12 Years old, how many Hours are since expired?

```
    12 Years        12 Years
  *365               6 Hours
  ----              --
  4380 Days         72 odd Hours in 12 Years
    24
  -----
 17520
 1760
 ------
105120 Hours
add 72 odd Hours
 ------
105122
```

* *Note*, Though I set 365 under 12, yet I multiply 365 by 12, because it is done in one Line.

SEC-

SECTION II.

Of COMPOUND REDUCTION.

Tyro. WHY do you call this *Compound Reduction?*

Philo. Becauſe it is compounded of *Multiplication* and *Diviſion*, and cannot be done without both.

Tyro. What is its particular Uſe?

Philo. It teaches us to reduce any Sort of foreign Money into Pounds *Sterling*, and the contrary; ſo that it is uſeful in all Buſineſs and Traffick, as appears by the following Table and Examples.

A ſelect ALPHABETICAL TABLE *of Foreign Coins.*

NAMES.	*Value Sterling.*	*What Country.*
Abaſhee	16 Pence	*Perſia*
Aſar	6 *s.* 8 *d.*	*Ditto*
Aſper	3 Farthings	*Turkey*
Beſſe	3 Halfpence	*Perſia*
Capan	3 Pence	*Eaſt India*
Capeck	1 Penny	*Muſcovy*
Cohan	30 Shillings	*Japan*
Chriſtiana	16 Pence	*Sweden*
Copſtake	1 Shilling	*Germany*
Cruſado	6 *s.* 2 *d.*	*Ditto*
Ditto	2 *s.* 10 *d.*	*Portugal*
A Crown	4 *s.* 6 *d.*	*France*
Ditto	5 *s.* 3 *d.*	*Florence*
Ditto	7 *s.* 6 *d.*	*Rome*
Ditto	1 *l.* 2 *s.*	*Barcelona*
A Dina	1 *l.* 10 *s.*	*Aleppo*
A Dollar	4 *s.* 6 *d.*	*Italy*
A Lion Dollar	4 *Shillings*	*Aleppo*
A Croſs Dollar	4 *s.* 2 *d.*	*Holland*
A *Specie* Dollar	5 *Shillings*	*Ditto*
A *Zealand* Dollar	3 *Shillings*	*Ditto*

Old

NAMES	*Sterling.*	*Country.*
Old Philip's Dollar	5 Shillings	*Holland*
Leopold's Dollar	4 *s.* 3 *d.*	*Ditto*
Rudolphus's Dollar	4 *s.* 4 *d.*	*Ditto*
Prince of *Orange*'s Dollar	4 *s.* 4 *d.*	*Ditto*
Maxamilian's Dollar	4 *s* 5 *d.*	*Ditto*
Ferdinando's Dollar	4 *s.* 3 *d.*	*Ditto*
Dollar	2 *s.* 3 *d.*	*Dantzick*
Dollar	2 *s.* 3 *d.*	*Sweden*
A Rix-Dollar of the Empire	4 *s.* 8 *d.* $\frac{1}{4}$	*Germany*
A Ducat	4 *s.* 8 *d.*	*Hungary*
Ditto	5 *s.* 3 *d.*	*Poland*
A *Valentia* Ducat	5 *s.* 3 *d.*	*Spain*
A *Saragoza* Ducat	5 *s.* 6 *d.*	*Ditto*
A *Barcelona* Ducat	6 Shillings	*Ditto*
Ducat	5 Shillings	*Naples*
A Ducatoon	6 *s.* 3 *d.* $\frac{3}{5}$	*Holland*
A Piece of Eight in common	4 *s.* 6 *d.*	*Spain*
A *Mexico* Piece of Eight	4 *s.* 6 *d* and 4 *s.* 4 *d.* $\frac{1}{2}$	*Ditto*
A *Peru* Piece of ditto	4 *s.* 5 *d.*	*Ditto*
A Florin	4 *s.* 4 *d.*	*Ditto*
Ditto	3 *s.* 4 *d.*	*Germany*
Ditto	2 *s.* 6 *d.*	*Sicily*
Ditto	2 Shillings	*Holland*
Greven	1 Shilling	*Muscovy*
Guilder, or Gilder	3 *s.* 8 *d.*	*Germany*
Ditto Gold	4 *s.* 9 *d.*	*Ditto*
Ditto of *Noremberg*	7 *s.* 1 *d.*	*Ditto*
Ditto	5 Shillings	*Portugal*
Ditto	18 Pence	*Dantzick*
A Harpur	9 Pence	*Irish*
A Livre is 20 Sous	18 Pence	*France*
A Mark	13 *s* 4 *d* not current	*England*
Ditto	16 Shillings	*Denmark*
Ditto	2 Shillings	*Germany*
Mark- Lups	3 *s.* 9 *d.* $\frac{3}{4}$	*Poland*
Messe	15 Pence	*East India*

Mill-

NAMES.	*Sterling.*	*Country.*
Mill-Ree (is 1000 Rees) ——	6*s.* 9*d* nearly	*Portugal*
A Moidore, marked 4000, or 4 Times 6 *s.* 9 *d.* *viz.*	27 Shillings	*Ditto*
An Obb or Cobb ½ a Harpur	4 *d.* ½	*Irish*
A Pattacoon, or Pettavoon	4 *s.* 8 *d.*	*Spain*
A Ruble ——————	10 Shillings	*Muscovy*
Seraph ——————	5 Shillings	*Turky*
Timph ——————	7 Pence	*Poland*
Tical ——————	2*l.* 16 *s.* 3*d.*	*China*
Tari ——————	5 Pence	*Sicily*
Toman Gold ——————	3 *l.* 6 *s.* 8 *d.*	*Persia*
Zachin ——————	7 *s.* 6 *d.*	*Venice*
Zelot ——————	7 *d.* ½	*Turky*

Here follows another useful Table.

A TABLE *of the just Weight of the customary Gold Coins used in* England.

	dwts.	*Grains.*
A Port	9 –	5
½ Port	4 –	14
A Moidore	6 –	22
½ Moidore	3 –	11
Guinea	5 –	9
½ Guinea	2 –	16
A Pistole	4 –	8

Note 1. These all weigh something more than is set down in the Table; but as it is fractional Parts I have omitted them.

Note 2. If a Guinea don't want above 7 Grains, a Moidore above 9, and a Six and Thirty above 12 Grains of Weight, you may safely take them.

Note 3. Scales and Weights for this Purpose are made by Mr. *John Kirk* in *St. Paul's Church-Yard, London.*

Tyro. I am obliged to you, Sir.

Philo. And now, *Tyro*, I will give a Variety sufficient for any careful Learner to do any Question relating to the common Course of Business: But before you begin, I would

would desire you to mind the two following Observations.

Observation 1. When any Sum of Money, or any Weight or Measure, is to be brought into another Sum of a different Name or Denomination; then always remember, that before you divide, you make the *Divisor* and *Dividend* of the same Name. That is, if the *Dividend* be Pounds, Pence, Yards, Shillings, *&c.* your *Divisor* must also be of the same Name.

Observation 2. Take Notice likewise, that your *Remainder* is always of the same Name as your *Dividend* and *Divisor*, be it what it will. These Observations kept in Memory will be of great Service to you in the *Rule of Three direct*, and in all common Rules of Arithmetic.

1. QUESTIONS *in* Compound REDUCTION.

In 324 Moidores, how many Pouuds?

	324	Moidores
1 Moidore	27	Shillings
	2268	
	648	
Shillings 2|0)	874|8	Shillings
£.	437 –	8 Shillings

2. A Merchant at *London* delivers to his Correspondent as much Broad-Cloth as comes to £. 547 – 14 – 7; and he is to receive the same in *Cross Dollars*, at 4 *s.* 2 *d* each: How many must he receive?

Rule.

Rule. Bring the Money into Pence, and divide by the Pence in 1 Dollar.

```
s.  d.          £. 547 - 14 - 7
4 - 2                 20
12              ----------
--              10954 Shillings
50                 12
                ----------
Pence in a Dollar 5|0)131455 Pence
                  ----------
                  26291 Crofs Dollars. Anf.
```

3 How many *Crufadoes*, at 6 *s.* 2 *d.* each, muft be paid for 1000 *Guilders* of *Noremberg*, at 7 *s.* 1 *d.* each?

```
        s.  d.      1000 Guilders
Crufado 6 - 2          85             s.  d.
        12        ---------           7 - 1 Guilder
        --        74)85000(1148       12
        74 Pence     74               --
                  -----               85 Pence
                     110
                      74
                  -----
                     360
                     296
                  -----
                      640
                      592
                  -----
                      48 Pence
```

Anf. 1148 Crufado's and 4 Shillings over.

Quest. 4. How many *Rix Dollars*, at 4 *s*. 3 *d*. $\frac{1}{4}$ each, may I receive for £. 1750 – 15 – 6 $\frac{1}{2}$ Sterling ?

Rule. Bring the Sterling Money into Farthings, and divide by the Farthings in 1 Dollar.

```
   s.   d.          £. 1750 - 15 - 6½
   4  - 3¼                 20
  12                ----------
  ---                  35015 Shillings
  51                      12
   4                ----------
  ---                 420186 Pence
 205                       4
                    ----------
Farthings in 1 Dollar 205)1680746(8198 R. Doll. Ans.
                      1640       and 156 Farth. or
                      ----        3 s. 3 d.
                       407
                       205
                      ----
                       2024
                       1845
                      -----
                        1796
                        1640
                      ------
                   by 4)156 Farthings over *
                      ------
                   by 12)39 Pence
                      ------
                         3 - 3 Pence
```

Tyro. * The *Remainder* I see is *Farthings* as well as the *Dividend*; and I suppose you divide it by 4, and by 12, to bring it into Pence and Shillings: Do you not ?

Philo. You say right; and all other Questions are done after the same Manner.

Quest.

Quest. 5. In 276 Crusado's, at 6 *s.* 2 *d.* each, how many *Hungarian* Ducats, at 4 *s.* 8 *d.* each?

```
 s.   d.          276 Crusado's
 4 -  8            74 Pence in a Crusado
12               ----                        s.  d.
--               1104                        6 - 2
56               1932                       12
                 ----                       --
Pence in a Ducat 56)20424(364 Ducats Ans.  74 d.
                    168
                    ---
                     362
                     336
                     ---  Ans. 364 Ducats, and 40
                      264  Pence over, or 3 s. 4 d.
                      224
                      ---
                       40 Pence over
```

Queſt. 6. In £. 347 – 11 – 5, how many *French* Crowns, at 4 *s.* 6 *d.* $\frac{1}{8}$ each?

£. 347 – 11 – 5
20

6951 Shillings
12

83417 Pence
8 Eighths in 1 Penny

A Crown $54\frac{1}{8}$ *d.*
8

433 Eighths

433)667336(1541 *Anſ.* 1541 *French* Crowns, and 10 *d* $\frac{3}{8}$.
433

2343
2165

1783
1732

516
433

8)83

$10\frac{3}{8}$

Here I multiply the Pence by 8, and the *Dividend* and the *Diviſor* an Eighth of a Penny, the Remainder alſo is 8ths of a Penny; therefore, I divide it by 8, and it is 10 Pence, and 3 Eighths over.

Note 1. As you do not underſtand *Fractions* as yet, it may not be amiſs to give you a Word or two by Way of Information. You ſee a *French* Crown in the above Example is valued at 54 *d.* 1 Eighth, that is, 54 Pence, and 1 Eighth of a Penny, which 1 Eighth is called a Fraction; the 1 which ſtands a-top, is called the Numerator, and the 8 is the Denominator: So alſo $\frac{3}{7}$ is read 3 Sevenths, $\frac{5}{11}$ is 5 Elevenths, and $\frac{3}{5}$ is 3 Fifths. Here 2, 5, and 3 are Numerators, and 7, 11, and 5 are the Denominators.

Note

Note 2. The Rule to work by Fractions in all ſuch Caſes as this, is thus. Multiply the whole Number by the *Denominator,* that is, the lower Figure of the Fraction, and take in the Top-Figure, or *Numerator.*

Queſt. 7. A Merchant ſends to his Correſpondent as much Corn as comes to £. 1575, to receive the ſame in *Ducatoons,* at 6 *s.* 3 *d.* $\frac{3}{5}$ each; how many ought he to receive?

s. *d.*
6 – $3\frac{3}{5}$
12
75
by 5 and take in the Top 3
378 Fiſths

£. 1725
20
31500 Shillings
12
378000 Pence
by 5 brings *d.* into 5ths

Diviſor 378)1890000(5000 Ducatoons.
1890 *Anſ.*
000

Queſt. 8. In £. 1000 how may 7 Pence Halfpennies?

£. 1000
20
20000 Shillings
12
240000 Pence
4
Farthings in 7 $\frac{1}{2}$ are 3|0)96000|0
32000 *Anſ.*

Or thus:
960 Farth.
1000
3|0)96000(0
32000 *Anſ.*

Quest. 9. In 100 *Portugal* Pieces, at 36 Shillings each, how many Pounds, Half Crowns, and Crowns?

Piece 36 Shillings
100

2|0)60|0 Shillings

180 Pounds
8 Half Crowns 1 Pound

2)1440 Half Crowns

720 Crowns

Here you see I multiply or divide always by as many of the *less* as make one of the *greater*, according as the Nature of the Question requires.

Quest.

Quest. 10. In 432 Moidores, how many Shillings, Crowns, Groats, and Farthings ?

	432 Moidores
	27 Shillings 1 Moidore
	3024
	864
Shillings in 1 Crown	5)11664 Shillings
Crowns	2332 4 *s.* over, or 12 Groats,
Groats in 1 Crown	15 and take in 12 Groats
	11662
	2333
	34992 Groats
Farthings in 1 Groat	16
	209952
	34992
	559872 Farthings

Tyro. I see now, Sir, the Nature of the Rule plainly ; but pray how do you manage when there is a Sum of Money to be paid in Pieces of different Value, and that there shall be as many in Number of one Sort as of another ; that is, an equal Number of every Sort ?

Philo. This is very useful in many Respects, and is done by this general Rule, *viz.* Add all the Pieces together ; then bring the Sum of Money to be paid, and the Sum of all the Pieces, into one Name or Denomination ; and *lastly*, divide the Sum to be paid by the Total of all the Pieces, and the Quotient is the Number of each, one with another.

Quest. 11. How many Shillings, 6 Pences, 4 Pences, 3 Pences, 2 Pences, Pence, Half-pence, and Farthings, of each a like Number, will discharge a Debt of £. 335 – 8 – 4? *Ans.* 2800 of each.

I set down all the Pieces one under another, as follows:

A Shilling is	12	
	6	
	4	
	3	£. 335 – 8 – 4
	2	20
	1	
	$\frac{1}{2}$	6708 Shillings
	$\frac{1}{4}$	12
Pence	$28\frac{3}{4}$	80500 Pence
	4	4
Farthings	115	115)322000(2800 Pieces of each Sort
		230
		920
		920
		00

Here I bring £. 335 – 8 – 4 into Farthings, and divide by 115, the Farthings in all the Pieces, and the Answer is 2800 of each.

OBSERVATION I.

1. When any Pieces of Money are to be brought into Pounds *Sterling*, you should consider what Relation those Pieces bear to a Pound *Sterling*; that is, what Part of a Pound it consists of; for by this the Work will be rendered much shorter, and you will not have Occasion to reduce

reduce the Work into Pence: But of this I ſhall ſhew you more fully in the *Rule of Three Direct*.

Queſt. 12. In £. 270 how many Nobles, at 6 *s*. 8 *d*. each?

270
3 Nobles, or 3 Times 6 *s*. 8 *d*. is 1 Pound

810 *Anſ*.

To bring Nobles into Pounds, divide by 3.

Queſt. 13. In £. 270 how many Marks, at 13 *s*. 4 *d*. each?

Here, as 13 *s*. 4 *d*. is 2 Thirds of a Pound, I multiply the Pounds by 3, and divide by 2, as follows.

270
3

2)810

405 Marks *Anſ*.

Tyro. This is much ſhorter than to bring the *Pounds* and the *Marks* into Pence, and have to divide beſides.

Philo. To be ſure it is, and when you want to bring *Marks* into *Pounds*, then multiply by 2, and divide by 3; for you muſt have leſs *Pounds* than *Marks*, becauſe a *Pound* is larger than a *Mark*. And thus, *Tyro*, by your Care and Obſervation, you may work many Sums ſhorter than the common Form of Rules in general laid down; for it is impoſſible (without a large Volume indeed, and even not then) to lay down Rules and Examples to make a careleſs Learner underſtand: But a diligent Learner, that is deſirous to know, and make himſelf perfect, will not only obſerve the Rules given

him, but will alſo try and contrive Methods of his own, and is not ſatisfied with knowing Things by Halves.

Queſt. 14. Suppoſe a Bill of Exchange was accepted at *London*, for £. 580, for Value received at *Amſterdam*, how many *Flemiſh* Pounds ought to be remitted at *Amſterdam*?

	33 – 4 One *F.* Pound	
	12	£. 580
		20
Diviſor	400 Pence	
		11600
		12
		4|00)1392|00
		Anſ. 348 *Flem.* Pounds.

Do you underſtand it?

Tyro. I do; for let the Queſtion be what it will, I have nothing to do but to make them both of a Name, and multiply, or divide by as many of the *leſs*, as make one of the *greater*; then the Quotient (if a Diviſion Sum) will be the Anſwer, and the Remainder the ſame as the Dividend.

Philo. Very well; then I will ſet you one Sum more for Trial.

Queſt. 15. A General of an Army (conſiſting of 5000 Men) after a very ſharp Engagement loſt 2380 Men; but coming off victorious, he, for their valiant Behaviour, gave 1000 Guineas to be equally divided among them, and the Remainder (if any) to be given to a little Errand-Boy: How much did each Man receive?

Tyro. I proceed thus: I take 2380 Men that were loſt, out of 5000, and there remains 2620 that eſcaped. Then I reduce 1000 Guineas into Farthings, and find it

it 1008000, and dividing this by the Number of Men that escaped, *viz.* 2620, I find the Quotient 384 Farthings, that is, just 8 Shillings each Man, and 192 Farthings remaining over, which is 4 Shillings for the little Errand-Boy, as appears by the following Work.

The Work.

5000 Soldiers
2380 killed
———
Divisor 2620 escaped.

1000 Guineas
21
———
21000 Shillings
12
———
252000 Pence
4
Men ———
262|0)100800|0(384 Farthings each
786
———
2220
2096
———
1240
1048
———
4)192 Farthings remains
———
12)48 Pence
———
4 Shillings for the little Boy.

4)384 Farthings
———
12) 96 Pence
———
8 Shillings each. *Ans.*

Philo. Very well done indeed.

LONG.

LONG-MEASURE.

Quest 16. How many Furlongs, Rods, Yards, Feet, Inches, and Barley-Corns will reach round the World, ſuppoſing it (according to the beſt Calculation) to be 25020 Miles?

25020	Miles *
8	
200160	Furlongs
40	
8006400	Rods
11	Half Yards in 1 Rod * *
by 2)88070400	Half Yards
44035200	Yards
3	
132105600	Feet
12	
1585267200	Inches
3	
4755801600	Barley-Corns

* According to this Calculation of 25020 Miles round the Globe, 69 $\frac{1}{2}$ Miles make 1 Degree. See the *Note* in *Page* 49, *Long-Meaſure*.

* * *Note*, That 5 $\frac{1}{2}$ Yards make 1 Rod; but becauſe I cannot well multiply by 5 $\frac{1}{2}$, I therefore multiply by 11, and they are $\frac{1}{2}$ Yards; and then divide by 2 to bring them into Yards.

Another

Another Way.

As 1760 Yards make a Mile, if you multiply 25020 by 1760, you will have the ſame Anſwer in Yards; and if you multiply the Yards by 36, you will have the Inches, *&c.*

SECTION III.

QUESTIONS *to exerciſe* REDUCTION.

1. IN £. 56 how many *Crowns* and *Six-pences?* *Anſ.* 224 Crowns, and 2240 Six-pences.

2. In 8568 Pence, how many Shillings and Guineas? *Anſ.* 714 Shillings, and 34 Guineas.

3. In £. 12 – 2 Shillings, how many Groats, 3 Pences, and 6 Pences? *Anſ.* 726 Groats, 968 Three-pences, and 484 Six-pences.

4. In 750 Pounds, how many Moidores and Guineas? *Anſ.* 555 Moidores, and 714 Guineas, and 6 Shillings over.

5. In 500 Pounds *Ports*, at 36 Shillings each, how many Pounds, Half Crowns, Crowns, and Groats? *Anſ.* £. 900, 7200 Half Crowns, 3600 Crowns, and 54,000 Groats.

6. In £. 500 how many Pieces, at 7 *d.* $\frac{1}{2}$, and Pieces at 7 *s*: 6 *d*. each? *Anſ.* 16,000 Pieces, at 7 *d.* $\frac{1}{2}$, and 1333 Pieces, at 7 *s.* 6 *d.* each, and $\frac{1}{3}$ of a Piece, or 2 *s.* 6 *d.*

7. A Merchant at *Holland* draws a Bill upon his Correſpondent in *London*, for 2500 Ducatoons, at 6 *s.* 2 *d.* $\frac{3}{5}$ each, how many Pounds *Sterling* ought he to receive at *London?* *Anſ.* £. 777 – 1 – 8.

Rule. Bring a *Ducatoon* into 5ths of a Penny, (as in *Page* 137) and multiply the Number of *Ducatoons* by them; then bring a Pound *Sterling* alſo into *Fifths* (*viz.*

1200 Fifths) and dividing by 1200, you will have the £. 777 $\frac{1}{12}$; that is, £. 777 one Twelfth of a Pound, or 1 *s.* 8 *d.*

8. A rich *Nobleman* has 5 Villages, in every Village 3 Streets, in every Street a Dozen Houſes, in every Houſe 5 Rooms, in every Room 2 Bureaus, in every Bureau 12 Drawers, in every Drawer 4 Bags, every Bag valued at 150 Guineas; which he is going to *exchange* for £. 3 – 12 Shillings Pieces, how many muſt he receive in all?

Rule. Multlply all the Numbers by one another as they follow in Order, and your laſt Product will be Guineas. Bring theſe Guineas into Shillings, and divide by 72, the Shillings in a £. 3 – 12 Piece, you'll have the Anſwer, which is 3780000 Pieces, at £. 3 – 12 Shillings each.

Inſtead of dividing by 72, which will make a long Sum, it is much ſhorter and eaſier to divide by 6 firſt, and then that Product divided by 12 gives the ſame Anſwer.

Tyro. Sir, I ſee it plainly, and will try to do them all, and prove their Anſwers, the firſt Opportunity.

Philo. Then I will now proceed to the moſt uſeful Rule in all common *Arithmetic*, *viz.* the *Rule of Three Direct*, commonly called the *Golden Rule of Three.*

DIA-

DIALOGUE VII.

SECTION I.

The Single Rule of Three Direct, *commonly called the* GOLDEN RULE.

Tyro. WHAT do you mean by the *Rule of Three Direct?*

Philo. The *Rule of Three* is the *Rule of Proportion*; because it ſhews what *Relation* or *Proportion* one Number bears to another.

Tyro. What is given, and what is required in the *Rule of Three?*

Philo. *Three* Numbers are given to find a *Fourth*, which is the Anſwer.

Tyro. How is the *fourth* Number found?

Philo. By this one *General Rule.* Multiply the ſecond Number by the Third, and divide by the Firſt.

Tyro. How does the Proportion of theſe 4 Numbers ſtand, or what Relation do they bear to each other?

Philo. As the *firſt* is to the *ſecond* Number, ſo is the *third* to the *fourth* Number. For if you multiply the *fourth* Number, or *Anſwer*, by the *firſt*, the Product will be the ſame as the *Third*, multiplied by the *Second*: But more of this by and by.

Tyro. How am I to work the *Rule of Three Direct?*

Philo. By the following Rule, which you ought ſo far to get by Heart, as to underſtand it without Book.

A Ge-

A General RULE.

1. When any 3 Numbers are given, place them one after the other, in Order, as they ſtand, and this is called ſtating the Queſtion.

This being done, multiply the *Second* by the *Third*, or the *Third* by the *Second* Number, and divide by the *Firſt*, you have the *fourth* Number, or Anſwer.

Let the three Numbers be 4, 8, and 12.

* 4 : 8 :: 12 to a 4th Number, *viz.* 96.

```
          8
         —
      4)96
         —
         24 Anſ.
```

* *Note*, That 2 Dots, one over a other, thus (:) ſignifies the Word *to*; and 4 Dots thus (: :) ſignify, or is read, *ſo is*: Thus 4 : 8 :: 12 : 96 is thus read: As 4 *to* 8, *ſo is* 12 *to* 96, and ſo for any other Number in Proportion.

Here you ſee the *fourth* Number, or Anſwer, is 24.

Now, *Tyro*, it is worth your while to obſerve what *Relation* or *Proportion* theſe bear to each other.

OBSERVATION I.

As the *Firſt* is to the *Second*, ſo is the *Third* to the *Fourth*. That is, as 4 is to 8, ſo is 12 to 24: For 4 is the Half of 8, and 12 is the Half of 24.

OBSERVATION 2.

As the *Firſt* is to the *Third*, ſo is the *Second* to the *Fourth*. That is, as 4 to 12, ſo is 8 to 24: For 12, the *third* Number, is 3 Times more than 4, the *firſt* Number; and 24, the *fourth* Number, is 3 Times more than 8, the *ſecond* Number. Or, in other Words, thus: The *Third* divided by the *Firſt*, is equal to the *Fourth* divided by the *Second*. And thus you will find the *Proportion* holds good,

good, take the Numbers which Way you will, as by the following *Obſervations*.

OBSERVATION 3.

The *firſt* Number is equal to the Product of the *ſecond* and *third*, divided by the *fourth*; that is, 96 divided by 24 is equal to 4.

OBSERVATION 4.

The *Second* is equal to the Product of the *Firſt* and *Fourth*, divided by the *Third*; that is, 96 divided by 12, is equal to 8.

OBSERVATION 5.

The *Third* is equal to the Product of the *Firſt* and *Fourth*, divided by the *Second*; that is, 96 divided by 8 is equal to 12.

OBSERVATION 6.

The *Fourth* is equal to the Product of the *Second* and *Third*, divided by the *Firſt*; that is, 96 divided by 4 is equal to 24 *.

Tyro. This is very pretty indeed! And will this *Proportion* hold ſo in any other 3 Numbers.

Philo. No Doubt of that; if you will try any 3, you will find they will anſwer to the foregoing *Obſervations*.

This is only to ſhew you, *Tyro*, the Nature of Proportion, relating to Numbers, without any particular Name; but as for working the *Rule of Three direct*, when the Numbers are called by the Names of *Pounds*, *Yards*, *Ells*, *Ounces*, *Pence*, or the like; that indeed is the Effect of Practice, and may very ſoon be learned by the following Inſtructions, or Directions.

* See more of this in my *Young Algebraiſt's Companion*, Dialogue 7, Section 2.

SEC-

SECTION II.

Containing some full and necessary Directions for the better performing this Rule.

Tyro. YOU have already told me, that there are always *three Numbers* given to find a *Fourth*; but in what Order am I to place them, when they are of a different Name, or Denomination; that is, *How am I to state the Question?*

Philo. Do you but mind the following Instructions, and read your Questions over slow, and considerately, and you will soon know how to *state* it, or place the Numbers in their Order; for I shall first of all give you Directions to work common easy Sums, and then shew you how to proceed when the *first* and *third* Numbers are not alike, and when there is required two or three Statings.

SECTION III.

Directions *to state and work easy Questions in the* Rule of Three Direct.

First, ALWAYS remember that when 3 Numbers are given, *two* of these Numbers always are of one and the same Name and Denomination, *viz.* either Money, Weight, or Measure, which *two Numbers* out of the *three*, must be your *first* and your *third* Number; and the other in Course must be placed in the Middle, which *middle Number* will always be of the same Name as the Answer. Thus, if the *second* or *middle Number* be *Money, Weight,* or *Measure*; so also will the *fourth Number* or *Answer* be.

2. If

2. If at any Time the *first Number*, or the *third*, be of a higher or greater Denomination than the other, then make them both of one Denomination by the Rules of *Reduction*. Thus, if the *first Number* be Yards, and the *third Number* Ells, reduce them both into Quarters, by multiplying the Yards by 4, and the Ells by 5; so also if the *first Number* be *lbs.* and the *third Cwts.* and *qrs.* you must reduce the *Cwts.* and *qrs.* into the *lbs.* that they may not only be of one Name, (Weight, Measure, *&c.*) but likewise the very same Name, *viz. Pounds, Pence, Yards, Quarters,* &c.

3. If your *second Number* be a compound Quantity, such as *Pounds, Shillings,* and *Pence,* or *Cwts. qrs.* and *lbs.* you must reduce it into Pence, or into *lbs.* by the Rule of *Reduction*; and remember, that after you have multiplied the *second* by the *third*, and divided by your *first*, the Quotient will be of the same Name as you reduced your *second* Number into, be it what it will.

4. In all Questions in the *Rule of Three*, where there is only 3 Numbers given, you have already been told, that *two* of those *three* will always be of one Name, and must be your *first* and *third* Numbers. Now, it is very easy to know which of those *two* must be your *third* Number: For whenever a Question is asked, or whatsoever Number follows the Question, *that* is your third Number. Thus, what cost 24 Yards? Or how much does 96 *lb.* cost? Here 24, or 96, will be your *third* Number; and so for any other Question, as you will see by the two first Examples, as follows:

Quest.

Quest. 1. If 3 Yards coſt 7 Shillings, what coſt 24 Yards?

Yards Shill. Yards
If 3——7——24
7 multiply
———
Divide by 3)168
———
by 2|0)5|6 Shillings.
———
2 *l.* 16 *s.* *Anſ.*

Proof, or Proportion.
As 3 : 7 :: 24 : 56. For 3 Times 56 is 168, and 7 Times 24 is 168. And thus for any other Queſtion.

Quest. 2. If 8 Ells coſt 11 Shillings, what coſt 96 Ells?

Ells Shill. Ells
If 8——11——96
11
———
8|1056
———
2|0) 13|2
———
7. – 6 – 12

☞ *Note*, Here you ſee that the Queſtion is aſked, what coſt 24 Yards, or what 96 Ells; therefore, you may be ſure theſe are to be your third Number. Then your *firſt* is plainly known by being of the ſame Name; and your *middle*, or *ſecond* Number, muſt be known of Courſe, which will always be the ſame Name as the Anſwer. See *Obſervation* 1.

Rule. Having ſtated the Queſtion, I multiply the *ſecond* by the *third* Number, or the *third* by the *ſecond*, and divide by the *firſt*, and the Anſwer is 56 Shillings, which is the ſecond Name as the *ſecond* Number; then I divide

divide those Shillings by 20, and have the Answer. The second Question is done the same.

Tyro. I see the Nature of it plainly; but there is a Way to prove Sums in the *Rule of Three*, by stating them backward, is there not?

Philo. Yes; and a very good Method it is, to confirm you in the Truth of what you have done; for the Question will then be turned quite the reverse Way.

First Proof, or Variation.

If 24 Yards cost 56 Shillings, what cost 3 Yds?

```
   Yards  Shill.  Yards
If 24 —— 56 —— 3
          3
        ————
      2)168(7 Shillings.  Ans.
        168
        ————
          0
```

Here you see the *fourth* Number in the original Question is the *first* Number in this Question; the Answer of the Original is the *second* Number; and the *second* Number in the Original is the *Answer* here.

Second Proof, or Variation.

If 7 Shillings buy 3 Yards, how many can I have for 56 Shillings?

Here I find 2 Numbers out of the 3 are Money, and the Number following the Queſtion (*how many*) is 56 Shillings; therefore, 56 Shillings is my third Number; which is thus ſtated.

$$
\begin{array}{llll}
 & \textit{Shill.} & \textit{Yards} & \textit{Shill.} \\
\text{If} & 7 \text{——} & 3 \text{——} & 56 \\
 & & & 3 \\
\hline
 & & 7) & 168 \\
\hline
 & & & 24 \text{ Yards, } \textit{Anſ.}
\end{array}
$$

So that you ſee, by minding which *Two* of the *Three* are of the ſame Name, it is no difficult Matter to ſtate any common Queſtion, and others more difficult will naturally follow by Uſe and Practice.

Tyro. I underſtand it very well indeed, and heartily thank you.

Philo. Then I ſhall proceed to give you more uſeful Examples, and when any Thing occurs that you don't rightly apprehend, aſk me, or read the Inſtructions over again.

Queſt.

Quest. 3. If 3 *lb*. of Tobacco, (or any other Thing) cost 2 *s*. 9 *d*. what cost 255 *lb*.

```
    lb.    s.     d.        lb.
If  3 ——— 2 ——— 9 ———— 255
          12*                33 Second Number
          —                ————
          33                765
                           765
                          —————
                          3)8415
                          —————
                         12)2805 Pence
                          —————
                         2|0)23|3-9
                          ————
                         £.11 - 13 - 9 Ans.
```

PROOF.

```
     Pence      lb.     Pence
If 2805 ——— 255 ——— 33
                  33
                 ————
                  765
                 765
                 ————
      2805)8415)3 lb.  Ans.
            8415
            ————
              0
```

* The *second Number* being *Shillings* and *Pence*, I bring them into Pence by multiplying by 12, and taking in the odd 9 Pence; and after I have multiplied the *third Number* 255 by 33, and divided by my *first*, which is 3, the Quotient is of the same Name still, *viz.* Pence, which

which I divide by 12, to bring into Shillings, and by 20 to bring them into Pounds, as above: And thus for any common Sum. See *Observation* 2.

Quest. 4. If an Ounce of Tobacco cost 5 Farthings, what cost 2 *C.* 3 *qrs.* 21 *lb?*

```
    oz.   Farth.  C.     qrs.   lb.
If *1 ——— 5 ——— 2 ——— 3 ——— 21
                4
              ————
               11 qrs.
               28
              ————
               89
               24
              ————
              329 lb.
               16
              ————
             1974
             329
              ————
             5224 oz.
                5 Second Number
              ————
         4)26320 Farthings
              ————
        12) 6580 Pence
              ————
        2|0) 54|8 - 4 d.
              ————
        £. 27 - 8 - 4 Ans.
```

* *Note,* Because the *first* Number is Ounces, I bring the *third* Number also into Ounces, to answer it; but after I have multiplied by my *second* Number 5, they are all Farthings; and as my *first* Number is only an Unit (or 1) I do not divide by *that*; for 1 neither multiplies nor divides; I therefore only divide the Farthings by 14, 12, and 20, and the Question is done. See the *Proof* in the next Question.

Quest.

Quest. 5. If 2 *C.* 3 *qrs.* 21 *lb.* (or 5264 Ounces) cost £. 27 – 8 – 4, what cost an Ounce !

	oz.	*£.*	*s.*	*d.*	*oz.*
If	5264 ——	27 –	8 –	4 ——	1
		20			
		548			
		12			
		6580			
		4			

5264)26320(5 Farth. *Ans.*
26320

0

☞ Take Notice, that whenever your *first* Number is large, and the *third* ſmall (as in this Example) that you always reduce the *middle*, or *ſecond* Number, to its loweſt Denomination.

Quest. 6. Bought a Silver Cup and Tankard, which weighed 3*lb.* 11 *oz. Troy*, and cost me £. 8 – 18 – 2½; what did they lie me in *per* Ounce?

Here, as the Question is, *What did they cost* per *Ounce?* You must know your Answer is to be in Money; so also must your *second* Number be, and the other two Numbers will naturally follow, thus:

```
    lb.    oz.              £.   s.   d.        oz.
If  3 ——— 11 ————————————— 8 – 18 – 2½ ———————— 1
   12 oz. 1 lb. Troy        20
   ——                     ————
   47 oz.                  178 Shillings
                            12
                          ————
                          2138 Pence
                             4
                          ————
                      47)8554(182 Farthings. Ans.
                         47
                        ————          4)182 Farthings
                         385          ————
                         376          12)45–2
                        ————          ————
                          94               3s. 9d. ½ per oz. Ans.
                          94
                        ————
                          •
```

Quest.

Quest. 7. A Gentleman has an Estate which brings him in clear £. 2000 a Year, and the Charges he is at, one Day with another, for House-keeping, and other Expences, is £. 5 – 15 *s.* I demand what he loses or saves every Year?

Rule See what £. 5 – 15 – *per* Day amounts to in a Year, and take it out of his yearly Income £. 2000 is what he saves; but if his Expences be more, take the £. 2000 from that, and the Remainder is what he loses.

```
      Day   £.   s.      Days
   If 1 —— 5 - 15 —— 365
           20             115
          ———            ———
          115            1825
                        4015
                        ————
                   2|0)4197|5 Shillings
                        ————
 Yearly Expences £. 2048 - 15

Yearly Expences  ——  £. 2048 - 15
Estate  ——  ——          2000 -
                       ————————
He loses Yearly  ——  £. 48 - 15  Ans.
```

Quest 8. A Farmer agreed with his Servant to thresh all the Corn he had, and the Servant was to receive a Guinea for every 7 Quarters: Now, he threshed in all 15 Loads, 1 Quarter, and has received of his Master, at different Times, by Cash and Goods, 9 Guineas; I demand how the Reckoning stands between them.

Rule. First, see what 15 Loads 1 Quarter comes to, at a Guinea, or 21 Shillings, *per* Quarter, and then subtract 9 Guineas out of it.

```
     qrs.    s.     Loads   qr.
If 7 —— 21 —— 15 —— 1
                5 qrs. 1 Load
             ------
               76 qrs.
               21
             ------
               76
              152
             ------
            7)1596
             ------
          2|0) 22|8 Shillings
             ------
          £. 11 - 8 Ans.
```

Servant's Wages for threshing —	£. 11 - 8	
He received 9 Guineas, *viz.* —	9 - 9	
Due to the Servant — —	£. 1 - 19	*Ans.*

Quest.

Quest. 9. A Corn-Factor ſends to his Correſpondent in *Spain* 10,000 Quarters of Wheat, and agreed at £8 – 7 – 6 *per* Load, and he has received by ſeveral Remittances £10,000; what is ſtill due to him?

Loads	*£.*	*s.*	*d.*	*qrs.*
If 1 ——	8 –	7 –	6 ——	10,000
5	20			
5 *qrs.*	167			
	12			
	2010 Pence			
	1000			

Wheat	£16750
Received	10000
Due to him	£6750

First Number 5)20100000
12)4020000 Pence

2|0)33500|0 Shillings

£.16750 *Anſ.*

Quest. 10. Bought 4 Bags of Hops, which weighed as under.

	C.	qrs.	lbs.
N° 1	2	3	11
2	1	2	27
3	2	1	17
4	1	3	15
	8	3	14

And gave after the Rate of 5 Guineas *per Cwt.* what do they come to?

C. £. s.
If 1 ——— 5 - 5
112 20
112 *lbs.* 1 *Cwt.* 105

C. qr. lb.
8 - 3 - 14 **
4
35 *qrs.*
28
284
71
994 *lbs.*
105
4970
9940

1st N° 112)104370(931 Shillings divided by 20, is £.46-11. So that the Answer is £.46 - 11 $10\frac{1}{2}$.
1008
357
336
210
112
98 Remainder
12
112)1176(10 Pence
112
56 Remainder
4
112)224(2 Farthings
224
0

** *Note,*

* * *Note*, I reduce the *first* and *third* into *lbs.* and the *second* into Shillings, and the *Quotient* is Shillings; and the Remainder 98 I multiply by 12, and divide by the same *Divisor*, (*viz.* 112) and it gives 10 Pence in the *Quotient*; and the next Remainder I multiply by 4, and it gives 2 Farthings.

* * ☞ See a shorter Way than either this, or *Page* 120, to bring *Cts. qrs.* and *lbs.* into *lbs. viz.* in *Example* 1, in *Tare* and *Tret.*

Quest. 10. There is a Ship worth £2000, of which I have the $\frac{7}{32}$ Parts: I demand what my Share is worth?

First, according to the common Order of the *Rule of Three*, I say,

```
   Parts                        Parts
If 32 be————£2000 what is 7
                    7
                 ————
         32)14000(437 Pounds
            128
            ————
             120
              96
             ————
              240       Ans. £437 - 10s.
              224
              ————
                16 Remainder
                20 Shillings in a £.
              ————
         32)320(10 Shillings
            32
            ————
              0
```

Note, I multiply the Remainder 16 by 20, and divide by the ſame *Diviſor* 32, and the Quotient is Shillings. Had any Thing remained I ſhould now have multiplied it by 12, and divided by 32, and the Quotient would have been Pence, *&c.*

Note, It often happens, that dividing by the Parts is both ſhorter and eaſier than dividing by the whole: Nothing but Practice and Obſervation can make a Man Maſter of this; for ten thouſand Rules without theſe are of very little Account.

OBSERVATION.

Here, according to the Nature of Queſtions of *Multiplication,* or *Diviſion* of Money, I perform the above Queſtion with Eaſe.

If 32 ———————— £2000 —— 7
Parts. *Parts.*

7
———
8 Times 4 is 32, *by* 8)14000
———
4)1750
———
Anſ. £437 – 10

Here I divide by 8, and by 4; when I divide by 4, I find 2 remain, which I call 2 Pounds; then I ſay the 4th Part of £2 is 10 Shillings. And now you may ſee the Beauty of *Multiplication* and *Diviſion of Money,* if you do but obſerve it well.

Tyro. I humbly thank you, Sir, and ſee there is Nothing like knowing the former Rules perfectly.

Philo. As I ſaid before, many Queſtions may be performed by *Multiplication,* and *Diviſion of Money,* if

if they be rightly applied, and much ſhorter and eaſier than the common Order of the *Rule of Three.* I ſhall give you one Inſtance, and no more, which, if well obſerved, will be ſufficient; for according to the Nature of the Queſtion, a great many Figures may be ſaved as well as Trouble.

Queſt. 11. Bought a Box of ſuperfine Tea, which weighed 2 *qrs.* 7 *lb.* and gave £.73 - 12 - $7\frac{1}{2}$ for it; what is 5 *lb.* of it worth?

Firſt, and common Way.

	qrs.	*lb.*	£.	*s.*	*d.*	*lb.*
If	2 —	7 —	73 -	12 -	$7\frac{1}{2}$ —	5
	28		20			
	63		1472 Shillings			
			12			
			17671 Pence			
			4			
			70686 *qrs.*			
			5 Third Number			

63)353430(5610 Farthings
315
—
384
378
—
63
63
—
0

Farthings
4)5610
—
12)$1402\frac{1}{2}$
—
20|0)11|6-10
—
Anſ. 5-16-$10\frac{1}{2}$

Short Way by Multiplication *and* Division of Money.

	lb.	*£.*	*s.*	*d.*	*lb.*
If	63 ——	73 -	12 -	$7\frac{1}{2}$ ——	5
				5	
63 is 9 Times	7)	368 -	3 -	$1\frac{1}{2}$	
	9)	52 -	11 -	$10\frac{1}{2}$	
		5 -	16 -	$10\frac{1}{2}$	*Ans.*

Here you see that the second Way has but about Half the Figures.

Tyro. I see it very plainly, and I think I am able to do any common Sum of but one *Stating.*

Philo. Then we will proceed to *Section* 4.

SECTION IV.

Contains some necessary Directions in more difficult Questions, and such as require more than one Stating.

Tyro. HOW am I to manage when the *first* and *third* Numbers are not of one Name, or Denomination.

Philo. Bring them into one Denomination (according to *Direction* 2, *Section* 1.) and proceed by multiplying your *second* by the *third,* and divide by your *first,* as before.

Quest.

Quest. 12. If 3 Yards cost 8 *s.* 3 *d.* what cost 96 Ells *English?*

Yards	*s.*	*d.*	*Ells English.*
If 3 ———	8 —	3 ———	96
4	12		5
12 *qrs.*	99		480 *qrs.*
			99
			4320
			4320
	First Number		12)47520
			12) 3960 Pence
			2|0) 33|0
			£. 16 – 10 *Anf.*

Rule. Here, becauſe the *firſt* Number is Yards, and the *ſecond* Ells *Engliſh*, I bring them both into Quarters, by multiplying the Yards by 4, and the Ells by 5, and then proceed as before.

First Proof, or Variation.

Quest. 13. If 96 Ells *English* cost £. 16 – 10*s.* what cost 3 Yards?

	Ells	£. *s.*	*Yards*
If	96	16 – 10	3
	5	20	4
	480 *qrs.*	330 Shillings	12 *qrs.*
		12	
		3960 Pence	
		12 Third Number	

First Number 480)47520(99 Pence. *Ans.* or 8 *s.* 3 *d.*
4320

4320
4320

0

☞ Here you see the *fourth* Number, or Answer, is the same as the *second* Number, in the last Question. See the next Question.

Second

Second Variation, or Proof.

Quest. 14. If I buy 3 Yards of Holland for 8 *s.* 3 *d.* how many Ells *English* may I have for £. 16 - 10.

☞ Here, because the Answer is to be in Measure, therefore Measure must be my second Number, thus:

```
    s.  d.     Yards         £.   s.
If  8 - 3 ——— 3 ——————— 16 - 10
   12                    20
   ——                  ————
   99 Pence             330 Shillings
                         12
                       ————
                        3960 Pence
                           3 Second Number
                       ————
First Number 99) 11880 (120 Yards
                  99
                 ———
                 198
                 198        Yards.
                 ———         120
                   0           4 qrs 1 Yard
                            ————
             Qrs 1 Ell 5)480 qrs
                            ————
                            96 Ells Ans
```

☞ Here you see I do not bring the second Number, Yards, into Quarters, as I did before in the other two Questions; for it is better to work with it as it is; because it saves a great many Figures, and the Answer will be 120 Yards, which I reduce into Ells very easily, by multiplying by 4, and dividing by 5; and if you consider all the three different Ways of working this Question, it will be of great Service to you.

Quest.

Quest. 15. A Draper bought 12 Pieces of Holland, each Piece containing 23 Ells *English*, and gave after the Rate of 3 *s.* 4 *d. per* Ell *Flemish*; what did they come to?

First 23 Ells 1 Piece
12 Pieces

276 Ells in all

Ell Fl.	*s.* *d.*	*Ells Eng.*
If 1 ————	3 - 4 ————	276
3 qrs 1 Ell *Fl.*	12	5
3 qrs	40 Pence	1380 qrs.
		40
		3)55200
		12)18400 Pence
		2|0) 153|3 - 4
		£. 76 - 13 - 4 *Ans.*

Tyro. I am obliged to you; and now, if you please, I will try at one.

Philo. With all my Heart; I like to see you in this Mind.

Quest.

Queſt. 16. A Woollen-Draper bought 4 Packs of Cloth, each Pack containing 3 Parcels, each Parcel 6 Pieces, and each Piece 40 Yards, and gave 3 *l.* 10 *s.* for every 6 Yards one with another; what do they come to?

Tyro. Firſt, I ſee how many Yards there are in all, by multiplying them together as they ſtand, thus:

4 Packs	*Yards* £. *s.*	*Yards*
3	If 6—3-10	——2880
	20	70
12 Parcels		
6	70	6)201600 Shillings
72 Pieces		2|0)3360|0
40		
		1680 *Anſ.*
2880 Yards in all		

Philo. Very right; and you may prove this Sum ſeveral Ways at Leiſure, which will be of Service. Firſt, £3 - 10 *s.* every 6 Yards, is 11 *s.* 8 *d.* for 1 Yard. Therefore ſay, if 1 Yard coſt 11 *s.* 8 *d.* what coſt 2880, and it will be the ſame Anſwer. And again, you know 2880 Yards, at £1 *per* Yard, is 2880; therefore ſay, If 20 Shillings be 11 *s.* 8 *d.* what will £2880 be; and you will have 1680 for Anſwer, as before.

Queſt.

Quest. 17. How many Dozen of Candles, at 5 *s.* 3 *d. per* Dozen, may I have in *Exchange* for 3 Pieces of *Irish*, each long 20 Ells, at 3 *s.* 9 *d. per* Yard?

Here is two Statings in this Question; First, see what the *Irish* comes to, and as the Question asks, how many Dozen of Candles, therefore 1 Dozen must be the *middle* Number of the second Stating.

First, 3 Pieces, each 20 Ells, is 60 Ells in all.

Yard	*s. d.*	*Ells*	*s. d.*	*Dozen*	*£. s. d.*
If 1 ——	3 - 9 ——	60.	If 5 - 3	be 1 —	14 - 1 - 3
4	12	5	12		20
4	45	300	63		281
	300				12

4) 13500

12) 3375 Pence

2|0) 28|1 - 3

£. 14 - 1 3 *Irish* cost

63) 3375 (53 Dozen
315
225
189
36
12 in 1 Doz.

63) 432 (6 Candles
378
54

Answer 53 Dozen and 6, that is, 53 Dozen and a Half. The Remainder 54, and all other Remainders, are placed Fraction-wise over the *Divisor*, thus $\frac{54}{63}$. So that the true Answer is 53 Dozen, and 6 Candles, and 54 sixty-three Parts of another Candle, or $\frac{6}{7}$, which wants but $\frac{1}{7}$ of another whole one.

Tyro.

Tyro. I underſtand it all but the $\frac{6}{7}$ths, how do you make that out.

Philo. You will ſee better when you come to *Vulgar Fractions*; for $\frac{6}{7}$ths is the ſame as $\frac{54}{63}$ For divide the *Numerator* 54 by 9, and it is 6, for a *new Numerator*, and divide 63 the *Denominator* alſo by 9, and it is 7. But the Anſwer without the Fraction is near enough, and you muſt not mind theſe Curioſities at preſent.

Queſt. 18. A Woollen-Draper bought a certain Quantity of Serge and Broad-Cloth for £. 500: The Quantity of Broad-Cloth he bought was 500 Yards, at 12 *s*. 6*d*. *per* Yard. Now he bought 3 Times as many Yards of Serge as he did Broad-Cloth. I demand how much each coſt, and what the Serge coſt *per* Yard?

Firſt, I find what the Broad-Cloth comes to

Yard,	*s*.	*d*.	*Yards*.
If 1 ——	12 –	6 ——	500
	12		
	150		
	500		
	12)75000		
	2|0) 625|0 Shillings		
	£312 – 10 *Anſ*. Broad-Cloth.		

	£.
Both of them coſt	500 – —
Broad-Cloth coſt	312 – 10
The Serge coſt	187 – 10

Here you ſee the Broad-Cloth coſt in all £ 312 - 10 *s*. which taken out of £ 500 (what they both coſt) the Serge then muſt coſt in all £ 187 - 10 *s*. Now the Queſtion ſays, he had 3 Times as many Yards of Serge as he had of Broad-Cloth, which is in all 1500 Yards, (that is, 3 Times 500) of Serge. Then to find how much the Serge coſt *per* Yard, I ſay,

If

	Yards		*£.*	*s.*	*Yard*
If	1500	cost	187	- 10 ——	1
				20	
				3750	
				12	

First Number 15|00)450|00(30 Pence, or 2*s* 6*d*. *Ans*. the Serge cost *per* Yard.
45
——
0

Tyro. Sir, I am highly obliged to you; and I perceive, that it is nothing else but considering the Nature of the Question, and two Statings are as easy done as one. But pray, if I may be so free, is not Interest cast up, or done by the *Rule of Three*.

Philo. There is a shorter Way of doing it, but it is very often perform'd by *the Rule of Three Direct*: So also, *Exchange*, *Loss* and *Gain*, *Barter*, *Fellowship*, and many such like Rules, though they bear those different Names, it is all but the *Rule of Three* in the Main: However, to satisfy you, I will give you an Example or two of each, to prepare you the better to work them.

1. *An* EXAMPLE *in* INTEREST.

Quest. 19. What is the Interest of £360 for three Years, at £$3\frac{1}{2}$ (or £3 – 10 *s.*) *per Cent. per Annum?*

Note, Remember that *per Cent.* signifies £100; so that in other Words it is thus: What comes the Interest of £360 to for 3 Years, at £$3\frac{1}{2}$ for every £100? Say,

```
     £.         £.   s.            £.
If 100———————3 – 10———————360
              20                  70
             ——               ————————
                           1|00)252|00
                          ————————
                           2|0)25|2   Shillings
                          ————————
                              12–12 for 1 Year Ans.
                                  3 Years multiply
                          ————————
                           £. 37–16 for 3 Years Ans.
```

And after this Manner any Sum, at any Rate *per Cent.* may be done.

Note, When there are odd Months you must allow in Proportion, thus: Suppose it had been six Months more, you see one Year, or twelve Months, is £12 – 12 *s.* therefore, six Months is half of it, *viz.* £6 - 6*s.* and 3 Months is £3 – 3*s.* more.

Quest.

Quest. 20. A Person left his Niece £650, to be paid to her when she came to proper Age, with Interest upon it at 4 *per Cent.* Now it lay in the Executors Hands 219 Days, what had she got to receive Principal and Interest in all.

First, I find the Interest for one Year.

```
    £.      £.        £.      Days     £.       Days
If 100 ——— 4 ——— 650. If 365 be 26 ——— 219
                   4                       26
              ———————                   ———————
              £26|00                      1314
                                          438
                                        ———————
                                     365)5694(15£.
                                         365
                                        ———————
                                         2044
                                         1825
                                        ———————
                                          219
                                           20
                                        ———————
                                     365)4380(12 Sh.
                                         365
                                        ———————
                                          730
                                          730
                                        ———————
                                            0
```

I cut off 2 Cyphers, which is the same as divided by 100, and the Answer is £. 26 for one Year's Interest.

Principal ———	£650 –
129 Days Interest is	15 – 12
Ans. The Niece has to receive	£665 – 12

2. *An*

2. *An* EXAMPLE *in* Bartering, *or* Exchanging. *See* Queſtion 17.

Queſt. 21. Two Merchants, *A* and *B*, *barter*, or *exchange* with one another in Traffic. *A* has Sugar, which he ſells at £4 *per Cwt*. for ready Money; but in *Barter* he will have £4 – 13 – 4. *B* has Wine at £13 *per* Hogſhead: Now the Queſtion is how much *B* ought to advance his Wine in *Barter*, to equal the Advance of *A*'s Sugar.

First, Sugar ———— £4 – 13 – 4 in *Barter*
For ready Money ———— £4 – –
£ – 13 – 4 Advance

£.	s.	d.	£.
Then, If 4 Advance	13	– 4 ————	13

12
160 Pence
13
480
160
First Number 4)2080
12) 520 Pence
2|0) 4|3 – 4
£2 – 3–4 *Anſ*.

Anſ. *B* muſt advance his Wine £2–3–4: So that in *Barter* his Wine is worth £15 – 3 – 4 *per* Hogſhead.

3. Ex-

3. EXAMPLES *in* Profit *and* Lofs, *or* Lofs *and* Gain.

Queft. 22. Bought 3 Pipes of Wine for 100 Guineas, one of which leaked, or ran out 23 Gallons; the Remainder I fold at the Rate of 3 Half Crowns *per* Gallon; what was my Gain or Lofs?

First, 1 Pipe is	126 Gallons	*Gall.*	*s. d.*	*Galls.*
	3	If 1	—7–6—	355
			12	90
3 Pipes is	378 Gallons		—	
	23 leaked out		90	12)31950
	355 Gallons left			2|0)266|2–6
			Sold for	£133-2-6

Made of the Whole £133 – 2 – 6
Coft 100 Guineas, *viz.* 105 – –

Gain ———— £ 28 – 2 – 6 *Anf.*

Queft.

Quest. 23. What is gained *per Cent*. that is, what is gained in laying out £100, when 1 Shilling brings in 14*d*. $\frac{3}{4}$?

First	14*d*. $\frac{3}{4}$	*d*.	*d*.	£.
1 Shilling	12	If 12 gain	$2\frac{3}{4}$ ——	100
	——		4	20
1 Shilling gains	$2\frac{3}{4}$		——	——
			11	2000 Shills.
				12
				24000 Pence
				11
				12)264000
				4)22000
				22) 5500
				2|0) 45|8-4

Gained *Ans*. £22-18-4

Quest.

Quest. 24. A Gentleman that ſaw very plainly he could not live upon the common Intereſt of his Money, ſet up as a common Brewer, and laid out £1000 for that Purpoſe, in fitting up an Office, and buying Utenſils; and Hops, Malt, Exciſe, Wages, and other Charges, at the Year's End, amounted to £4000 more; in which Time he ſold as much Beer as came to £6875. I demand what he gained in all, and how much he gained *per Cent.*

First, Beer amounted to ——— £6875
His Charges are ——— ——— 5000

Gained in one Year ——— 1875

£. £. £.
If 5000 gain 1875——100
100

*5|000)187|500

£37—2500 remains
20

5|000)50|000

Anſ. He gained in all £1875, which is £37·10*s.* *per Cent.*

10 Shillings

* *Note,* I cut off 3 Cyphers in the *Diviſor,* and 3 Figures in the *Dividend* to anſwer them; then I divide 187 by 5, and it is 37, and 2 over, which I place before the 500 that I cut off, makes 2500 remain, which I multiply by 20, and cut off 3 Cyphers, and divide by 5 only, gives 10 Shillings.

4. Ex-

4. EXAMPLES *in* Company *called* Fellowſhip.

Queſt. 25. Two Tradeſmen or Merchants, *A* and *B*, enter into Partnerſhip, and purchaſe one common Stock; *A* put in £1750, and *B* put in £1050, and they gain the firſt Year of Trading £800 clear: What is the Share of each, according to the Sum each advanced at firſt?

Rule. In all Queſtions of this Nature the Rule is, Add together what every Perſon firſt put into Stock; and then ſay, as the *whole Stock* is to the *Gain* or *Loſs*, ſo is what every Perſon ſeparately put in to his particular *Gain* or *Loſs*: That is, the *whole Stock* added together is your *firſt* Number, the *Gain* or *Loſs* your *ſecond* Number, and what every Man ſeparately put in is your *third* Number; and the different Anſwers, or *fourth* Number, will be every Man's proper Share.

The Work.

A put in ——— ———	£1750
B put in ——— ———	1050
Whole Stock ——— ———	£2800

If 2800 gain 800 —— 1750 *A*'s Stock
800

28|00)14000|00(500 £. *A*'s Gain
140

00

	£.	£.	£.	
Secondly, If	2800 gain	800 ——	1050 *B*'s Stock.	
			800	

28|00)8400|00(300£. *B*'s Gain.
84

00

Anf. *A*'s Share of the Gain is —— £500
B's Share is 300

Gain —— —— 800 *Proof*

☞ *Note*, If the *Gain* or *Loss* be Pounds, Shillings, and Pence, reduce it accordingly, and your Answer will be of the same Name; and if there be Remains, add them together, and they will be always equal to the *Divisor* if the Work be right, and you must carry one to the next Denomination when it happens so.

Quest. 26. A Person broke, in Debt for £1890; but he gives up all his Effects to his Creditors, which amounted to £661–10*s.* how much then must each Creditor receive in the Pound?

Note, Had each Person's Debt been specified, there must have been as many different Statings, but in this Case but one, thus:

	£.	£.	s.	£.
If	1890 be	661 –	10 ——	1
		20		

1890)13230(7 Shillings in the Pound. *Anf.*
13230

0

PROOF.

PROOF.

Debt	1890
	7
	20)1323|0
	£661 - 10 Effects

Now, ſuppoſe, for Example's Sake, that any of the Creditor's Debt or Demand was £58, what muſt he receive? Say, If £1 be 7 Shillings, what will £58 be, and you will find it £20-6 for his Part; and ſo for the others, be they more or leſs.

Tyro. I am extremely obliged to you, Sir, for your explaining Things to me in this Manner.

Philo. I have no other Aim but your Advantage; nor ſhould I have been ſo long and particular, but that your Knowledge in this *Rule* is the Foundation of all the higher Rules, and even of the *Mathematics* itſelf. Thouſands of Examples more, 'tis true, might be given you; but as they depend upon what you have ſeen, and your conſtant Practice, I ſhall give you but one more, which in ſome Meaſure varies from the former ones.

Quest. 27. A Woollen-Draper bought of a Clothier an equal Quantity of four Sorts of Cloth, which coſt him £367 – 10*s*. Some coſt 18*s*. 6*d*. ſome 14*s*. 3*d*. ſome 11*s*. 6*d*. and ſome 4*s*. 9*d*. *per* Yard: How many Yards of each had he?

Rule. The Method of working all Sums of this Sort is this: Add all the different Prices together into one Sum, which is the *firſt* Number; then 1 Yard, or 1 *lb*. &c. will be your *ſecond* Number, and the whole Sum laid out your *third* Number.

The Work.

	s.	d.
First, I add all the different Prices thus:	18	– 6
	14	– 3
	11	– 6
	4	– 9
	£2 9	–

```
   £.   s.    Yard     £.    s.
If 2 -  9 ——— 1 ——— 367 ——— 10
   20                  20
   —                 ————
   49 Shillings      49)7350(150 Yards of each
                        49        Anſ.
                      ————
                        245
                        245
                      ————
                         0
```

Tyro. I perceive the Nature of it plainly.

Philo. Indeed, *Tyro*, if you underſtand theſe Examples, you are able to ſolve any common Queſtion relating to Buſineſs.

N. B. My Intent, *Tyro*, was to have given you here a Notion of *Timber-Meaſure*, and how to *gauge* a common Caſk, Cooler, or Piece of Malt, &c. or to meaſure any

any regular Piece of Ground; it being not only diverting, but alſo uſeful in the Country, and very ſatisfactory to Parents, when their Children have ſome Knowledge of theſe Things. But I ſhall reſerve this for a Dialogue by itſelf, and only leave you a few Queſtions for Practice.

QUESTIONS *to exerciſe the Learner in the* Rule of Three.

28. The Rents of a whole Pariſh amount to £1750, and a Rate is granted of £32 – 16 – 3; what is that in the Pound? *Anſ.* 4$d\frac{1}{2}$.

29. A Bankrupt is indebted £2980 – 10*s.* but all his Effects amount but to £931 – 8 – $1\frac{1}{2}$; what have his Creditors in the Pound? *Anſ.* 6*s.* 3*d.*

30. Bought a Lighter of Coals, containing 33 Chaldrons, 12 Buſhels, for which I gave £50; what do they lie me in *per* Buſhel? *Anſ.* 10*d.*

31. Bought of a Goldſmith 4 *lb.* 11 *oz.* 10 *dwts.* of Plate, at 5 *s.* 4*d. per* Ounce; what does it come to? *Anſ.* £15 – 17 – 4.

32. What is the Intereſt of £631 – 5*s.* for a Year, at 3 *per Cent?* *Anſ.* £18 – 18 – 9.

33. What comes the Commiſſion of £245 – 6*s.* to, at $2\frac{1}{2}$ *per Cent.?* *Anſ.* £6 – 2 – $7\frac{3}{4}$, $\frac{1}{5}$?

34. What muſt I give for the $\frac{6}{32}$ Parts of a Ship, that is worth £635 – 5*s.* *Anſ.* £119 – 2 – $2\frac{1}{4}$.

35. Shipped for *Barbadoes* 500 Pair of Stockings, at 3*s.* 6*d. per* Pair, and 1650 Yards of Baize, at 15*d per* Yard; and I have received in Return 348 Gallons of Rum, at 6*s.* 8*d. per* Gallon, and 750 *lb.* of Indigo, at 16*d. per lb.* what remains due upon my Adventure? *Anſ.* £24 – 12 – 6.

Rule. See what the Stockings and Baize come to, and add them together; then ſee what the Rum and Indigo both come to, and ſubtract it from the other, you'll find the Anſwer as above.

36. How many Bricks 9 Inches long, and 4 Inches wide, will floor a Room 18 Feet ſquare; that is, 18 Feet wide, and 18 Feet long?

Rule. Firſt, find the Content of the Room in Square Feet, that is, multiply the Length by the Breadth; then multiply that Product by 144, will bring it into Square Inches: This done, multiply the Length of the Brick by the Breadth, it is 36 Inches, which is your Diviſor, and the Anſwer is 1296 Bricks.

37. How many 10 Inch Tiles will floor a Malt Kiln 16 Feet long, and 14 Feet wide. *Anſ.* 322 $\frac{56}{100}$ *Rule.* Multiply 10 by itſelf, is the Contents of one Tile in Square Inches; then find the Contents in the Room in Inches, and divide by 100, it is 322, and better than a Half.

38. Bought a Ton of Iron, which coſt £19 – 10*s.* there being in Number 32 Bars: I deſire to know the Price of each, and what they weigh one with another. *Anſ.* 12*s.* 2*d.* $\frac{1}{4}$, and each Bar weighs 2 *qrs.* 14 *lb.*

39. There is a Ciſtern that holds 4 Hogſheads of Water, (allowing 63 Gallons to the Hogſhead) in which are placed 2 Pipes, the larger of which will diſcharge 1 $\frac{1}{2}$ Gallon every Minute; but if they both be ſet open they will diſcharge 2 $\frac{1}{4}$ Gallons every Minute: I demand in how long Time the Ciſtern will be filled by each Pipe alone, and in how long when they are both ſet open together. *Anſ.* The greater Pipe will fill it in 2 Hours, 48 Minutes; the ſmall one in 5 Hours, 36 Minutes; and both in 1 Hour, 52 Minutes.

40. There is a Steeple, which ſtands right upon level Ground, whoſe Shadow meaſures 75 Yards, at the ſame Time that the Shadow of a ſtraight walking Stick, which is a Yard long, meaſures 5 Feet: I demand the Height of the Steeple. *Anſ.* 45 Yards.

41. As

41. As I was beating on the Forest-Grounds,
Up starts a Hare before my two Greyhounds:
The Dogs being light of Foot, did fairly run
Unto her 15 Rods, just 21.
The Distance that she started up before
Was 4 Score, 16 Rods just, and no more:
Now this I'd have you unto me declare,
How far they ran before they caught the Hare.

Ans. 336 Rods.

DIALOGUE VIII.

SECTION I.

The RULE *of* THREE *Inverse, or* Reciprocal Proportion.

Tyro. WHAT do you mean by the *Rule of Three Inverse?*

Philo. It is often called the *Rule of Three Reverse*; that is, it is contrary to the *Rule of Three Direct.* For, as in the *Rule of Three Direct*, you multiply your *second* Number by your *third*, and divide by your *first*; here you multiply your *second* by your *first*, or your *first* by your *second*, and divide by your *third*, and the *fourth Number* is the Answer.

Note, Your *third* and *first* Number must be of the same Name or Denomination, as in the *Rule of Three Direct*, and the *fourth* Number, or Answer, will be of the same Name as the *second* Number.

Quest. 1. How many Yards of Shalloon, 3 qrs. wide, will line 4 Yards of Cloth, which is 5 qrs. wide? *Ans*. 6 Yards $\frac{2}{3}$.

As in the *Rule of Three Direct*, so here also, the *Question*, or Demand, lies upon the *third* Number.

```
   qrs. Yards  qrs.
If 5 —— 4 —— 3
         5 First Number
        ——
    3)20
        ——
Ans. 6⅔
```

Ans. 6 Yards, and 2 remains, which I place a-top of the 3, thus, $\frac{2}{3}$, and it is 2 Thirds. So is the Answer 6 Yards $\frac{2}{3}$.

Quest. 2. If when Wheat is 3*s*. 6*d*. a Bushel, the Three-penny Loaf weighs 4 *lb*. 2 *oz*. what ought it to weigh when the Wheat is 5 Shillings a Bushel? *Ans*. 2 *lb*. 11 *oz*.

```
    s.   d.         lb.  oz.                       s.
If  3 -  6 ———————— 4 - 2 ———————————————————————— 5
   12               12 oz. 1 lb. Troy              12
   ——               ——                             ——
   42 Pence         50                             60
                    42
                   ———
                   100
                  200
                 ————
            6|0)210|0
                 ————
              12)  35 oz.
                 ————
                 2 lb. 11 oz. Ans.
```

Quest. 3. A Regiment of Soldiers, consisting of 1000 Men, are to have new Coats, each containing 3 Yards, 2 qrs. of Cloth, that is, 6 qrs. wide, and they are to be lined with Shalloon that is Yard wide; how much Cloth will it take for their Cloaths, and how much Shalloon will line them? *Ans.* 5250 Yards.

First, see how much is in their Cloaths, thus:

1 Coat is 3 *Yards*, 2 *qrs*.
4
―――
that is 14 *qrs*.
1000
―――
14000 *qrs*. in all

qrs. *qrs*. *Yard*
Then, If 6 ―― 14000 ―― 1 Shalloon
6 4 *qrs*.
―――
Third Number 4)84000
―――
4)21000 *qrs*.
―――
5250 Yards *Ans.*

Quest. 4. An Acre of Land contains (according to the Table) 40 Rods in Length, and 4 in Breadth; what must be the Length to make an Acre, when the Breadth is 15 Rods?

```
Breadth     Length     Breadth
If 4————————40————————15
             4
           ———
       15)160(10 Rods
           15
           ———
            10
             5½ Yards 1 Rod
           ————                  Rods Yds. Feet
        15)55(3 Yards.      Ans.  10 - 3 - 2
           45
          ———
           10
            3 Feet in 1 Yard
          ————
       15)30(2 Feet
          30
         ———
          0
```

Quest. 5. If £100 in 12 Months gain £4 Interest, what Principal will gain as much in 8 Months? *Ans.* £150.

```
Months    £.        Months
If 12———100——————8
          12
         ———
      8)1200
        ————
        £150 Ans.
```

Quest.

Queſt. 6. An Army of Soldiers, conſiſting of 800, beſiege a Town, having with them Proviſion for 3 Months; but as they could not take the Town in that Time, the General was willing to make the ſame Proviſions laſt 5 Months, allowing each Man the ſame daily Proviſion: The Queſtion is, how many Men muſt be diſcharged, that the Proviſion may laſt 5 Months?

Months	*Men*	*Months*	*Men*
* If 3 ——	800 ——	5	800 for 3 Months
	3		480 for 5 Months
	5)2400		320 Diſcharged
	480		

Anſwer 480 kept, and 320 diſcharg'd.

The laſt QUESTION *varied.*

* *Note,* This Queſtion is ſet in Words on Purpoſe, *Tyro,* to puzzle you; but you muſt obſerve, that in all ſuch Sort of Sums, the Circumſtance of what is done is never to be minded: For, Suppoſe I ſhould ſay thus:

If 800 Men in 3 Months eat 10000 Penny-Loaves; how many will eat the ſame in 5 Months, at that Rate? *Anſ.* 480 Men, as before: So that the Action or Circumſtance of what they do is Nothing, let it be Eating, Drinking, or any other Thing.

Tyro. I underſtand you, Sir, and thank you for this Obſervation; and I think you have given me ſufficient Examples.

Philo. All other Queſtions are done after the ſame Manner. If you are perfect in theſe, you will eaſily do the following ones.

QUESTIONS

QUESTIONS *to exercise this* RULE.

Quest. 7. If when Wheat is sold for 3*s*. 9*d*. a Bushel, the Six-penny Loaf weighs 5*lb*. 10*oz*. How much ought it to weigh when it is Half a Crown a Bushel? *Ans*. 8*lb*. 9 *oz*.

Quest. 8. How many Yards of Matting, that is 2 Feet wide, will cover a Room 20 Feet long, and 18 Feet wide. *Ans*. 180 Feet, or 60 Yards.

Quest. 9. How many Yards of Paper, 3 qrs. wide, will be sufficient to hang a Room that is 24 Yards round, and 4 Yards high? *Ans*. 128 Yards.

Tyro. These Questions are sufficient, Sir.

Philo. Then we will proceed to *Section* 2.

SECTION II.

Of Plural Proportion, *called the* Double Rule of Three Direct.

Tyro. WHAT is *Plural Proportion*, or the *Double Rule of Three Direct*?

Philo. *Plural Proportion* is when 2 Numbers are given to find a Sixth; which six Numbers, or Answer, is found by two Statings of the *Single Rule of Three Direct*?

Tyro. This is very difficult I imagine; for, how am I to know how to make the first Stating.

DEFINITION *and* RULE.

Philo. In every regular Sum in the *Double Rule of Three Direct*, the first 3 Numbers always shew the Condition, or Supposition; and the other two, that is, the two last,

laſt, ſhew the Demand. The Anſwer of the Queſtion will always be the ſame as the *middle* Number; and the *firſt* and *third* muſt be of the ſame Name in both Statings, like as in the *Single Rule of Three Direct*.

Tyro. Cannot theſe Queſtions be done at one Stating?

Philo. Yes, by a Rule generally called the *Rule of Three of* 5 *Numbers*, and that with a great deal more Eaſe, as you ſhall ſee by and by; but we will give an Example here.

Queſt. 1. If £. 100 in 12 Months gain £. 4 Intereſt, what will £. 175 gain in 9 Months. *Anſ*. £. 5 – 5 *s*.

```
          £.      £.       £.
First, If 100 gain 4 what—175
                             4
                          ————
                     1|00)7|00
                          ————
                        £. 7
```

Here I find £.175 gains £. 7 in twelve Months. Therefore, I ſay in the ſecond Stating.

```
       Months   £.    Months
       If 12———7———————9
                9
               ———
             12)63
               ———
             £. 5  And 3 s. remains
                         20
                         ——
  Same Diviſor         12)60
                          ——
                           5 Shillings
```

Or thus,

You may begin with the *second, third,* and *fifth* Numbers.

First, If 12—be—4———9 *Ans.* £. 3.

£. £. £.
Then, If 100—3———175 *Ans.* £. 5 – 5 as before.

Note, See the Proof of this Question in the first Example of the next *Rule Inverse.*

Quest. 2. If 600 Seamen in one Week eat 1500 *lb.* of Beef; how many *lb.* will serve 120 Seamen 12 Weeks? *Ans.* 3600 *lb.*

Here I say first,

	Men		*lb.*		*Men.*		*lb.*
If	600	——	1500	——	120	*Ans.*	300

	Wk		*lb.*		*Wks*		
Then if	1	——	300	——	12	*Ans.*	3600 *lb.*

All Questions in this Rule being done after the same Manner, I shall leave other Examples for the *Rule of Three of five Numbers,* by which they are done with more Ease; and shall only give you a Notion of stating Questions here and in the *Double Rule of Three Inverse.*

Tyro. I humbly thank you, Sir.

Philo. There are many other Ways of varying this Rule; but this is sufficient for your Purpose.

SEC-

SECTION III.

The Double Rule of Three Inverse, *called also* Plural Proportion.

Tyro. WHAT is the Difference between this Rule and the last?

Philo. A great deal: For though here be 5 Numbers given to find a *sixth*, yet you will find it much more difficult to *state* the Question here than in the other; but observe the following Direction.

RULE.

1. As in the *Double Rule Direct*, so also here are 3 Numbers in the Supposition, and 2 in the Demand.

2. Place the Numbers in Order, as in the last Rule, *viz.* 3 in one Row, and 2 in the next, leaving that Number with a blank Place under, which will be the same Name as your Answer, observing well where the Supposition lies.

3. This being done, you state the Question with 3 Numbers first, as before; which is wrought according to the *Single Rule of Three Inverse*.

☞ If your first Stating be *Direct*, the second must be *Inverse*; for both are never *Direct*, nor never *Inverse*.

Quest.

Quest. 1. If £. 100 Principal * in 12 Months gain £. 4 Interest, what Principal will gain 5 Guineas (*viz.* £. 5 – 5 *s.* in 9 Months. *Ans.* £. 175.

* *Note,* The Word Principal signifies the Money that is put out to Interest.

	£.	£. Princ.	£.	s.
First *direct*, If	4 ——	100 ——	5 ——	5
			Ans. 131 —	5 *s.*

	Months	£.	s.	*Months.*	
Second Inverse, If	12 ——	131 ——	5 ——	9	*Ans.* 175

This is a Proof to the first Question of the last Rule.

Quest. 2. If 600 Seamen in 1 Week eat 1500 *lb.* of Beef, how long will 4500 *lb.* serve 120 Men at that Rate.

	lb.	*Week*	*lb.*	
First Direct, If	1500 ——	1 ——	4500	*Ans.* 3 Weeks.

	Men	*Weeks*	*Men*	
2dly Inverse, If	600 ——	3 ——	120	*Ans.* 15 Weeks.

Note, This Question is a Proof of the Second Question in the last Rule; only I varied one of the Numbers, *viz.* 3600 to avoid Fractions; but you will find the same Question in Example the Second in the next Rule of five Numbers.

Tyro. I understand it a little, but cannot say I am perfect in it.

Philo. It is of no great Signification at present; for you will see more of it in the next Rule.

SEC-

SECTION IV.

The Rule of Three *composed of* Five Numbers.

Tyro. WHAT Difference is there between this and the other two preceding Rules?

Philo. Only this, that all Questions in the *Double Rule of Three Direct* and *Inverse*, are performed here at one Stating.

Tyro. So you said before, I remember; please, therefore, to give me a Rule to work it by; for I think that is much better than the Trouble of two Statings.

Philo. It is so in general, but not always: However, it is easier, and better for the Learner upon the whole; for here, as well as in the two former Rules, the Difficulty lies to know whether the Question be *Direct*, or *Inverse*. This being known, the Manner of stating the Question will be easy, and the Work as easy.

A standing Rule to state Questions.

1. As in the *Single Rule of Three Direct*, so also here, the *middle Number* governs the Question; and the Answer will be of the same Name.

2. Having noted which the *middle Number* is, the other 4 are easily known; for the *two* that are in the Supposition always are the *two* before the *middle Numbers*; the other *two* are the Demand under the *third* and *fourth* Numbers.

Lastly, Always observe, that your *first Number* be of the same Name as your *fourth*; and your *second Number* the same Name as your *fifth*. This being done,

1. *The Rule for all* Direct *Questions is this.*

Multiply your *first* Number by your *second*, for a *Divisor*, then multiply your *third*, *fourth*, and *fifth* together, and divide their Product by the Product of the *first* and *second*; and the *Quotient* will be of the same Name as the *middle Number*, be it what it will, and is the *Answer*.

Ex-

EXAMPLE. *The first Question of the two last Rules.*

Quest. 1. If £. 100 in 12 Months gain £. 4 Interest, what will £. 175 gain in 9 Months. *Ans.* £. 5 – 5 *s.*

```
   £. Months     £.    £.   Months
If 100—12 gain 4——175——9
    12                  9
   ————            ————
   1200              1575
                        4
                   ————
             12|00)63|00
                   ————
       Ans. £. 5 – 3 remains over.
                       20
                    ————
                    12)60
                    ————
                         5 Shillings
```

Ans. £. 5 – 5 *s.* See the first Example of the last Rules.

Quest. 2. If 600 Seamen, in 1 Week, eat 1500 *lb.* of Beef; how many *lb.* will serve 120 Seamen 12 Weeks?

```
   Men  Week   lb.    Men  Weeks
If 600———1———1500———120———12
      1          120
   ————       ————
    600       180000
                  12
              ————
        6|00)21600|00
              ————
              3600 lbs. Ans.
```

See *Example* 2, in the *Double Rule Direct.*

Another

Another Rule for the more easy stating a Question.

1. *Note,* If you observe the two foregoing Examples, they are stated just as the Numbers follow one another in the Words of the Question; but it very often happens that the Numbers in the Sum lie contrary to the Order they ought to be placed in; therefore, you should turn the Question into other Words and it will be easier. Or,

2. Set all the Numbers down as they run in the Question, writing the Names over each; then consider what your Answer is to be in, and place that down afresh for the *middle Number*; then the *two* where the Demand lies must be your *fourth* and *fifth*, and the other *two* your *first* and *second* Numbers: The *first* must be the same as the *fourth*, and the *second* the same as the *fifth*. See the next *Question*.

Quest. 3. If £. 4 be the Wages of 8 Men 10 Days, what will it cost me, or what must be the Wages of 32 Men 12 Days? *Ans.* £. 19 – 4 *s.*

Here, as before directed, I place the Numbers after one another, thus:

	£.	*Men*	*Days*	*Men*	*Days*	
If	4——	8——	10——	32——	12	wrong stated.

Now, here the *middle Number* is Days, but should be Money, because the Question says, What will it cost me for 32 Men 12 Days; therefore Money must be my middle Number, and then, *Tyro*, the true *Stating* will appear easy as follows.

	Men	*Days*	*£.*	*Men*	*Days*	
Thus*,	8——	10——	4——	32——	12	*Ans.* *£.* 19 – 4 *s.*

Now here, *Tyro*, the Stating runs like the Words of the Sum, as follows, which is very natural.

* If 8 Men in 10 Days cost me £. 4 for Wages, what will 32 Men cost me in 12 Days at that Rate? *Ans.* as before.

Quest.

Quest. 4. (*A Proof of the first Question in the last Rule*) A Person put out 175 Pounds to receive Interest, and when it had continued 9 Months, he received Principal and Interest together £. 180 – 5 *s.* I demand at what Rate *per Cent. per Annum*, he put his Money out at? *Ans.* £. 4 *per Cent. per Annum.*

Here the Words of the Question are not like the *Stating.* You must observe then to proceed as under, in all Questions of this Nature.

Rule. Take the Principal from the Interest and Principal together, the Remainder will be the Interest for the Time it continued, and then the Stating will follow.

Thus,	Principal and Interest		£. 180 – 5 *s.*
	Principal put out	——	175 –
	Interest for 9 Months	—	£. 5 – 5 *s.*

	£.	Months		£.	*s.*			£.		Months	
If	175	—9	gain	5 –	5	Interest,	what will	100	in	12	?

Here, according to the Rule, bring your *middle Number* into Shillings; then multiply it by your *fourth* and *fifth*, for a *Dividend*; this done, multiply your *first* and *second* together for a *Divisor*, and the Quotient will be 80 Shillings, or £. 4, the Rate he put the Money out at.

Tyro. I heartily thank you; and I find by this I shall be able to answer Mr. *Cocker*'s last Question in the *Double Rule of Three Direct*, which before always appeared very difficult to me.

Philo. You say very right, *Tyro*, for the Question is done after the very same Manner; therefore I shall give you only two or three Examples in the *Double Rule of Three Inverse*, and leave you to practice the other Examples.

QUES-

QUESTIONS *Inverse.*

2. The Rule for *Questions Inverse* is as follows: The 3 Numbers belonging to the Suppoſition muſt be your *firſt*, *ſecond*, and *third* Number, and the Demand is your *fourth* and *fifth* Number. Theſe being obſerved, the Rule is, Multiply your *ſecond*, *third*, and *fourth* together for a *Dividend*, and your *firſt* and *fifth* together for a *Diviſor*, and the *Quotient* is the ſame Anſwer as your *middle Number*.

Queſt. 1. (*A Proof to the very laſt Queſtion, and of Queſtion* 1 *in the laſt Rule*) If £. 100 in 12 Months gain £. 4 Intereſt, what Principal will gain 5 Guineas in 9 Months?

Here, as the Principal is to be the Anſwer, ſo the Principal (*viz.* £. 100) muſt be your *middle Number*.

J. *Months* £. £. *s.* *Months*
If 4—12 be 100 Principal, what 5 – 5 be 9 *Anſ.* 175.

I ſtate the Queſtion according to the firſt ſtanding Rule, making my *firſt* and *fourth*, and my *ſecond* and *fifth* alike; this done, I bring my *firſt* Number into Shillings (*viz.* 80) becauſe the *fourth* muſt be brought into Shillings: This being done, I multiply the *ſecond*, *third*, and *fourth* together for a *Dividend*, and the *firſt* and *fifth* together for a *Diviſor*, and the *Quotient* is £. 175, the Principal required.

Queſt. 2. If 600 Seamen in 1 Week eat 1500 *lb.* of Beef, how long will 3600 laſt 120 Seamen?

lb. *Men* *Week* *lb.* *Men*
If 1500——600——1——3600——120

Here I multiply the *ſecond*, *third*, and *fourth* together for a *Dividend*, which is 2160000, and my *firſt* and *fifth* for a *Diviſor*, which is 180000, and the *Quotient* is 12 Weeks.

Queſt.

Quest. 3. If it cost me £. 240 for 60 Servants in 8 Weeks, how long will £. 140 serve me for 8 Servants? *Ans.* 35 Weeks.

Tyro. Sir, these Examples are sufficient, I think.

Philo. If you are well grounded in the Nature of the Rule, that is enough; for you may set yourself Sums at any Time by Way of Exercise. And now, *Tyro*, I will give you a Notion of *Tare* and *Tret*.

SECTION V.

TARE *and* TRET.

Tyro. WHAT do you mean by *Tare* and *Tret*?

Philo. *Tare* and *Tret* are Allowances made in buying and selling Commodities that are liable to Loss or Waste.

Tyro. What are the general Names belonging to this Rule.

Philo. They are 6, *viz.* *Gross*, *Tare*, *Tret*, *Suttle*, *Cloff*, and *Neat*.

Tyro. Please to explain these in their Order.

Philo. *First*, *Gross* signifies the whole Weight of any Commodity, or Parcel of Goods, Bag, or Box, or Cask, and all included, thus: Suppose I had a Box of Tea, Bag of Spice, or Cask of Oil, which weighs 120 *lb.* I say it weighs 120 *lb.* *Gross*.

Secondly, *Tare* is an Allowance made for the Weight of the Box, Bag, or Cask, and what hangs about it, and is to be taken out of the *Gross*, and then the Remainder is called the *Neat*, or *Clear Weight* of the Commodity: Thus, Suppose the foregoing Box, Bag, or Cask, after the Goods are out, should weigh 16 *lb.* then

I say,

I say, it has 16 *lb.* *Tare*, which I subtract out of the *Gross* 120 *lb.* there remains 104 *lb.* *Neat*, thus:

Bought a Box of Tea,	*Gross*	120 *lb.*
	Tare	16 *lb.*
	Neat	104 *lb.*

Thirdly, *Tret* is an Allowance of 4 *lb.* for every 104; that is, 1 *lb.* is allowed for every 26 *lb.* for such Commodities as are liable to Waste, Moths, Dust, *&c.*

Note, When there is *Tret* in the Sum, then after the *Tare* is taken from the *Gross*, the Remainder is called *Suttle*, instead of *Neat*.

Note 2. To find the *Tret* Pounds, divide the *Suttle* Pounds by 26, and the *Quotient* in the *Tret*, which subtracted from the *Suttle* gives the *Neat*.

Thus, A Box of Tea,	*Gross*	120 *lb.*
	Tare	16
26)104(4 *Tret*		
104	*Suttle*	104 *lb.* which divide by 26
	Tret	4 *lb.*
	Neat	100 *lb.*

Fourthly, *Suttle* Pounds are so called (as was said before) when there is *Tret* in the Sum; for when there is no *Tret* there is no *Suttle*, and the *Tret* Pounds are always subtracted out of them, as in the above.

Fifthly, *Cloff* is an Allowance of 2 *lb.* for every 3 *Cwt.* for the Turn of the Scale, and for small Draughts; but this is allowed only in some particular Things, and Cases.

Sixthly, *Neat* Weight is the *clear* Weight of the Commodity after all the Allowances are made.

Tyro.

Tyro. Sir, I underſtand you very well; but, if I remember, you told me, (in *Page* 163) you would ſhew me a ſhorter Method to reduce *Cwts.* and *qrs.* into *lbs.* than you did in *Page* 120.

Philo. I did ſo; and will now ſhew you all the Ways, and leave you to take your Choice.

To reduce Hundreds *and* Quarters *into* Pounds.

EXAMPLE I. Reduce 17 *C.* 3 *qrs.* 15 *lb.* into *lbs.*

First Method

```
              C.  qrs.  lb.
              17 - 3 - 15
               4
             ----
              71
Common Way    28
             ----
             573
             143
             ----
      Ans. 2003 lbs.
```

Second Method

```
          C.  qrs.  lbs.
          17 - 3 - 15*
          17
         17
         17
Add      99 for the 3 qrs.
        ----    15 lbs.
Ans.   2003 lb.   See p. 120.
```

* *Note*, In this Method you muſt always ſet the *C*'s down 4 Times, *viz.* twice under one another, and the other two, each one place more towards the Left-hand; then count how many *lbs.* there are in the odd *qrs.* and *lbs.* (which here are 99) and always place them under the *Units*, *Tens*, as above, and adding them together, you have the *Anſwer*.

Note, This Method is *ſhorter* than the *firſt*, and more particular when there are many Figures in the given *Hundreds*.

Third

Third Method. Multiply by 112, and take in the odd Pounds.

C.	qrs.	lb.		C.		lb.
17 -	3 -	15	is	17	and	99
				112		

Anſ. 2003 *lbs.*

* Here I multiply by 112 in 1 Line, thus: I ſay, 12 Times 7 is 84, and 9 odd *lbs.* make 93, 3, and I carry 9; then 12 Times 1 is 12, and 9 I carried is 21, and the other 9 I take in alſo is 30, that is 0, and I carry 3. *Laſtly*, I ſay, once 17 is 17, and 3 I carried is 20, which I place by the Side of the other 2 Figures, and it is done.

This is alſo ſhorter than the *firſt Method*, but ſomething more difficult till you learn to multiply by 112 very well, as you will in *Example* 2.

☞ *Fourth Method.* The beſt Way (in my Opinion) is this laſt Method, which is this: Multiply the *C*'s by 12 only, always remembering to place the two firſt Figures out towards the Right-hand; then ſet the odd Pounds under, and add them together as they ſtand, it is done.

	C.	qrs.	lbs.		C.	lbs.
Thus,	17 -	3 -	15	is	17 -	99 **
					204	
					99	

Anſ. 2003 *lbs.* as before

There is no Occaſion to ſet down the 12 under the 17, when you multiply; for it is eaſy to remember you multiply by 12. I ſay then, 12 Times 7 is 84, (which I place 2 Figures towards the Right hand of the 17) that

that is 4, and I go 8; then 12 Times 1 is 12, and 8 is 20, which I place to the Left of the 4, so that the 2 falls under the 7; then I set down the 99 odd Pounds, and add them together, they make 2003 *lb.*

** *Note*, But you may do it yet shorter by Use, and full as easy, and that is by taking in the 99 as you multiply, which will save the Trouble of adding it afterwards.

	C.	lb.
Thus,	17—	99
	303	
	2003	

Here I say, 12 Times 7 is 84, and 9 is 93, 3, and I carry 9; 12 Times 1 is 12, and 9 I carry is 21, and the last 9 belonging to the 99 makes 30.

Now, the Reason of this will appear plain, if you consider that 17 *C.* is 1700 *lb.* and 17 Times 12 *lb.* therefore, I only set down 1700 *lb.* and add 12 Times 17 to it.

Thus, 17 *C.* is ——	1700
More, 12 Times 17 is	204 add
Ans.	1904 *lbs.* in 17 *C.*

	1700—99 *lb.*
This	303 is 12 Times 17, and 99.
	2003 as before.

☞ *Note*, Or you may do it shorter yet, only by putting or joining the odd *lbs.* by the Side of the *C*'s, (making a Dot between them for Distinction Sake) then multiply the *C*'s only by 12, placing 2 Figures out from them,

them, as before directed, and you have the Answer, which will save the Trouble of taking in.

	C.	lb.		C. lb.
Thus,	17	– 99	I set down	17.99
				204
			Ans.	2003 *lb.*

Here I multiply 17 only by 21, always placing the two first Figures to the Right-hand; then add the two Lines together.

Example 2. In 47 *C.* 1 *qr.* 26 *lb.* *Neat*, how many *lbs.*

	C.	qr.	lb.		C. lb.	
Here	47	– 1	– 26	is	47.54	multiply 47 only by 12,
47 multiplied by 12 is					564	
					5318 *Ans.*	

Example 3. In 86 *C.* 1 *qr.* 17 *lb.* *Neat*, how many *lbs.*

	C.	qr.	lb.		C. lb.
Here	86	– 1	– 17	is	86.45
86 multiplied by 12				is	1032
					9677 *Ans.*

Here I join the odd 45 *lb.* close to the 86 *C.* and then multiply 86 only by 12, placing two Figures out as before.

Tyro. Very well, Sir; I understand what you have shewn me; but suppose the odd Pounds amount to three Figures, may I join them to the *C*'s then?

Philo. No, no; but one will appear as easy as the other by one Example only.

Example 4. Reduce 89 *C.* 3 *qrs.* 21 *lbs.* into *lbs.*

	C.
	89
3 *qrs.* 21 *lbs.*	105 *lb.*
89 multiplied by 12 is	1068
Anſ.	10073 *lb.*

* Here I ſet down the *C's*, and place the *Firſt* of the 3 Figures (which will always be a 1) under the *Units* Place of the *C's*, and multiply the 89 *C's* by 12, as before, ſetting the Product under 105.

And now, *Tyro*, I will prove this laſt Example by the other three Methods, and leave you to take your Choice as Practice or Fancy direct.

C. *qrs.* *lbs.*		*C.* *lbs.*		*C.* *lbs.*
89 – 3 – 21	*Secondly,*	89 – 105	*Thirdly,*	89 – 105*
4		89		112
359		89		10073 *lbs.*
28		89		
2873		105		
720		10073 *lb.*		
10073 *lb.* Common Way.				

* This third Method is certainly very ſhort, if once you can multiply well by 112: For obſerve, I ſay 12 Times 9 is 108, (and 5 the odd *lbs.*) is 113; 3, and I carry 11; then 12 Times 8 is 96, and 11 is 107, and the 10 *lb* is 117, that is 7, and I carry 11; *laſtly*, I ſay *once* 89 is 89, and 11 I carried is 100.

Tyro. Sir, I heartily thank you; I ſee now how it is done.

Philo. Then I will give you one Example at large.

Ex-

Example 5. Bought 3 Hogsheads of Sugar, as under.

		C.	qrs.	lbs.
Gross N°	1	11	2	15
	2	15	1	17
	3	17	3	14
Gross		44	3	18
Tare		1	1	2
Suttle		43	2	16

Tare of all 1 *C.* 1 *qr.* 2 *lbs.* *Tret* 4 *lb.* for every 104, at 56 Shillings a *C. Neat*, what come they to?

Suttle lbs.	4888 *lbs.*
Trett	188 *lbs.*
Neat	4700 *lbs.*

lbs.

26)4888)188 *Tret*

26

228

208

208

208

C. lb.

Then, If 1 *viz.* 112 cost 2 *l.* 16 *s.* what cost 4700 *lbs.* *Neat?* *Ans.* 117 – 10 *s.*

Example 6. Bought 3 Casks of Tea, each weighing *Gross*, 1 *C.* 3 *qrs.* 12 *lbs.* *Tare* of each, 1 *qr.* 5 *lb.* at 4 *s.* 9 *d.* a *lb.* *Neat:* What come they to?

Here being no *Tret*, the *Tare* taken out of the *Gross*, the Remainder is *Neat.* *Ans.* £. 124 – 13 – 9.

Tyro. I am highly obliged to you, Sir; and am now ready for the next Rule, if you please.

Philo. The next Thing I shall instruct you in is the Rule of *Practice*.

DIALOGUE IX.

SECTION I.

Of PRACTICE.

Tyro. WHAT do you mean by *Practice*?

Philo. *Practice* is only *Division of Money*, and very much resembles *Reduction ascending*; for here you divide by as many of the *Less* as make one of the *Greater*. It is a short contracted Way of the *Rule of Three Direct*, and saves the Trouble of stating Questions, by dividing by the Parts contained in the Whole.

Tyro. Are not *Vulgar Fractions* often taught before *Practice*?

Philo. They are; but there is no Necessity for it; if you can read a Fraction that is enough. Thus, $\frac{2}{7}$, $\frac{3}{4}$, $\frac{1}{8}$, or $\frac{1}{12}$, are thus read, 2 *Sevenths*, 3 *Fourths*, 1 *Eighth*, and 1 *Twelfth*.

Tyro. I know this very well Sir.

Philo. Then you may proceed to work this Rule as soon as you please; but it will be necessary to learn the following Tables by Heart.

TABLE

TABLE 1

Even Parts of a Shilling.

Pence		
6	is	½ of a Shill.
4		$\frac{1}{3}$
3		$\frac{1}{4}$
2		$\frac{1}{6}$
1½ *qrs.*		$\frac{1}{8}$
1		$\frac{1}{12}$
¾		$\frac{1}{16}$
½		$\frac{1}{24}$
¼		$\frac{1}{48}$

TABLE 2.

Even Parts of a £. Sterling.

Shillings		
10	is	½ of a £.
6-8*d.*		$\frac{1}{3}$
5		$\frac{1}{4}$
4		$\frac{1}{5}$
3-4*d.*		$\frac{1}{6}$
2-6*d.*		$\frac{1}{8}$
2		$\frac{1}{10}$
1-8*d.*		$\frac{1}{12}$
1-3*d.*		$\frac{1}{16}$
1		$\frac{1}{20}$

Tyro. I will learn these Tables as fast as I conveniently can.

Philo. Very well; then I shall proceed to give you Examples under the following *Cases.*

CASE 1.

When the Sum is given in Farthings, that is 1, 2, or 3 Farthings *per lb.* or Yard; then only bring these Farthings into *Pence, Shillings,* and *Pounds,* and the Work is done.

¼	¼	1753 *lb.* at ¼ *per lb.*
1*d.*	12	438¼
1*s.*	2|0	3|6-6*d.*
		£1-16-6¼ *Ans.*

Here 1753 lbs. at a Farthing a lb. is 1753 Farthings; therefore, I only divide by 4, by 12, and by 20, and have £1-16-6¼ for Answer.

$\frac{1}{2}$*ny* $\frac{1}{2}$ 1753 *lb.* at $\frac{1}{2}$*ny* a *lb.*
1 *d.*   12   876 - $\frac{1}{2}$
1 *s.*   2|0   7|3 -
£3-13-0$\frac{1}{2}$ *Ans.*

Here 1753 is 1753 Halfpence. I divide therefore by 2 to bring them into Pence, and by 12, and 20, to bring them into £'s, and the Answer is £-3-13-0$\frac{1}{2}$, which is just double the first Sum, at a Farthing a lb. and is a Proof to it.

* $\frac{3}{4}$ $\frac{1}{8}$ 1753 *lb.* at $\frac{3}{4}$ *per lb.*
6*d.* $\frac{1}{2}$ 219 - $\frac{3}{4}$
1 *s.*   2|0   10|9-6
£5-9-6$\frac{3}{4}$ *Ans.*

Here I say 3 Farthings is the 1 Eighth of 6 Pence, and dividing by 8, I have 219 Six-pences, and 3 Farthings over; then I divide by 2 (because 6d. is $\frac{1}{2}$ a Shilling) and have 109 Shillings, and 6 d. over; then I divide by 20, to bring them into £'s, and have £5 - 9 - 6$\frac{3}{4}$.

Note, If you add the Answers of the *first* and *second* Sum together, you will find them amount to £5-9-6$\frac{3}{4}$, which proves the Work.

* There is another Way to do this: Multiply 1753 by 3 Farthings; and the Product is Farthings; then divide by 4, 12, and 20.

1*d.*

	1753 *lb.* at $\frac{3}{4}$ *per lb.*
	3
4	5259
12	1314 – $\frac{3}{4}$
2|0	10|9-6
	£5-9-6$\frac{3}{4}$ *Ans.*

d.		*Yards*
1	$\frac{1}{12}$	1753 *at 1*d. per* Yd.
	2|0	14|6 – 1
		£7-6-1 *Ans.*

* *Note*, I make Use of the same Number 1753, because you may prove the Work of one Sum by another, by adding the Products of any two together, thus; the Product of 3 Farthings and 1 Farthing will prove the last Sum of a Penny.

CASE 2.

When the given Price is Pence and Farthings, then take the Parts for the Pence first, and then the Parts for the Farthings.

d.		*Ells* *d.*
1	$\frac{1}{12}$	1753 at 1 $\frac{1}{4}$ *per* Ell.
$\frac{1}{4}$	$\frac{1}{4}$	146 – 1*d.*
		36 – 6$\frac{1}{4}$**
	2|0	18|2 – 7$\frac{1}{4}$
		£9 – 2 – 7$\frac{1}{4}$ *Ans.*

** Here, I say 1 Penny is the $\frac{1}{12}$ of a Shilling; then I say, 1 Farthing is the $\frac{1}{4}$ of a Penny, and dividing 146 Shillings by 4, I have 36 Shillings, and 2 remains, which is 2 Shillings; then I say, the 4th of 2 Shillings is 6*d.* and the 4th of a Penny is $\frac{1}{4}$; then I add them both together, which make 18*s.* 7*d.* $\frac{1}{4}$, and dividing by 20, I have £9-2-7$\frac{1}{4}$ for *Ans.*

☞ Always remember that what remains is Shillings and Pence, and you must also divide such

Shillings

Shillings by the same Figure, and you have the true Answer.

d		lb.
$1\frac{1}{2}$	$\frac{1}{8}$	1753 at $1\frac{1}{2}$ *per lb.*
	2|0	2 |9 – $1\frac{1}{2}$
		10 – 19 – $1\frac{1}{2}$ *Ans.* *

* This you see is just double the Sum of 3 Farthings.

d.		lb.
$1\frac{1}{2}$	$\frac{1}{8}$	1753 at $1\frac{3}{4}$
$\frac{1}{4}$	$\frac{1}{6}$	219 – $1\frac{1}{2}$
		36 – $6\frac{1}{4}$ *
	2|0	25|5 – $7\frac{3}{4}$
		£12 – 15 – $7\frac{3}{4}$ *Ans.*

* *Note*, Here I say 3 Half-pence is the $\frac{1}{8}$th (as before) then I say, 1 Farthing is the $\frac{1}{6}$th of 3 Halfpence, and dividing by 6, I have 36, and 3 remains, which 3 I call 3 Shillings; then I say, the 6th Part of 3 Shillings is 6 Pence, and the 6th Part of $1\frac{1}{2}$ is $\frac{1}{4}$ Thus you see I take the Parts of the Remainder as well as the Parts of the Whole.

Pray observe, *Tyro*, and look well at the Example; for I shall now leave you to yourself for a while.

		Yards
2*d*	$\frac{1}{6}$	1753 at 2*d.* *per* Yd.
	2|0	29|2 – 2*d.*
		£14 – 12 – 2 *Ans.*

		lb.
2*d*	$\frac{1}{6}$	1753 at $2\frac{1}{4}$
$\frac{1}{4}$	$\frac{1}{8}$	292 – 2*d.*
		36 – $6\frac{1}{4}$
	2|0	32|8 – $8\frac{1}{4}$
		£16–8–$8\frac{1}{4}$ *Ans.*

		oz. d.
2*d*	$\frac{1}{6}$	1753 at $2\frac{1}{2}$
$\frac{1}{2}$	$\frac{1}{4}$	292 – 2*d.*
		73 – $0\frac{1}{2}$
	2|0	36|5 – $2\frac{1}{2}$
		£18–5–$2\frac{1}{2}$

Eli

		Ells
2*d*	1/8	1753 at 2*d*¾
½ ¼	¼ ½	292 - 2*d*. 73 - 0½ 36 - 6¼
	2|0	40|1 - 8¾
		£20-1-8¾ *Ans.*

		lb.
3*d*	¼	1753 *at* 3*d*
	2|0	43|8 - 3
		£21-18-3 *Ans.*

		lb.
3*d*	¼	1753 at 3*d*¼
¼	1/12	438 - 3 36 - 6¼
	2|0	47|4 - 9¼
		£23-14-9¼ *Ans.*

		lb. *d.*
3*d*	¼	1753 at 3½ *lb.*
½	1/6	438 - 3*d*. 73 - 0½
	2|0	51|1 - 3½
		£25-11-3½

		lb. *d.*
3*d*	¼	1753 at 3¾ *lb.*
¾	¼	438 - 3*d*. 109 - 6¾
	2|0	547 - 9¾
		27-7-9¾ *Ans.*

		Dozen
4*d*	⅓	1753 at 4*d*.
	2|0	58|4 - 4
		£29-4-4 *Ans.*

		lb. *d.*
3*d*	¼	1753 at 4¼ *lb.*
1*d* ¼	⅓ ¼	438 - 3 146 - 1 36 - 6¼
	2|0	62|0-10¼
		£31-0-10¼ *Ans.*

		lb. *d.*
4*d*	⅓	1753 at 4½ *lb.*
½	1/8	584 - 4 73 - 0½
	2|0	65|7 - 4½
		£32-17-4½

lb.

4d	$\frac{1}{3}$	1753 *lb.* at 4*d.* $\frac{3}{4}$ *lb.*
$\frac{1}{2}$	$\frac{1}{8}$	584 – 4*d.*
$\frac{1}{4}$	$\frac{1}{2}$	73 – 0$\frac{1}{2}$
		36 – 6$\frac{1}{4}$
	2|0	69|3 – 10$\frac{3}{4}$
		£34–13–10$\frac{3}{4}$

4d	$\frac{1}{3}$	1753 *lb.* at 5*d.* *lb.*
1d	$\frac{1}{4}$	584 – 4
		146 – 1
	2|0	73|0 – 5
		£36–10–5 *Ans.*

Ells

4d	$\frac{1}{2}$	1753 at 5*d.* $\frac{1}{4}$
1d	$\frac{1}{4}$	584 – 4
$\frac{1}{4}$	$\frac{1}{4}$	146 – 1
		36 – 6$\frac{1}{4}$
	2|0	76|6 – 11$\frac{1}{4}$
		£38–6–11$\frac{1}{4}$ *Ans.*

4d	$\frac{1}{2}$	1753 *lb.* at 5*d.* $\frac{1}{2}$ *lb.*
1d	$\frac{1}{4}$	584 – 4
$\frac{1}{2}$	$\frac{1}{2}$	146 – 1
		73 – 0$\frac{1}{2}$
	2|0	80|3 – 5$\frac{1}{2}$
		£40–3–5$\frac{1}{2}$ *Ans.* *

* Or you may take the Parts thus, *viz.* 4*d.* is $\frac{1}{3}$ of a Shilling, as before.

Or thus,

4d		1753 *lb.* at 5*d.* $\frac{1}{2}$ *lb.*
1$\frac{1}{2}$	$\frac{1}{3}$	584 – 4*d.*
	*$\frac{1}{8}$	219 – 1$\frac{1}{2}$
	2|0	80|3 – 5$\frac{1}{2}$
		£40 – 3 – 5$\frac{1}{2}$ *Ans.*

* Here I say, 1$\frac{1}{2}$ is $\frac{1}{8}$ of a Shilling, and take it out of 1753, the Top-line, which answers the same End as the last Work

		lb. *d.*
4d	$\frac{1}{3}$	1753 at 5 $\frac{3}{4}$
1$\frac{1}{2}$	$\frac{1}{8}$	584 – 4*d.*
$\frac{1}{4}$	$\frac{1}{6}$	219 – 1$\frac{1}{2}$
		36 – 6$\frac{1}{4}$
	2|0	83|9 – 11$\frac{3}{4}$
		£41–19–11$\frac{3}{4}$ *Ans.*

6d	$\frac{1}{2}$	1753 *lb.* at 6*d.* *lb.*
	2|0	87|6 – 6
		£43–16–6 *Ans.*

Yards

		Yards
3*d*	$\frac{1}{4}$	1753 at 6*d*. $\frac{1}{4}$ *Yd.*
d.		
3*	$\frac{1}{4}$	438 – 3
$\frac{1}{4}$	$\frac{1}{12}$	438 – 3
		36 – 6$\frac{1}{4}$
	2|0	91|3 – 0$\frac{1}{4}$
		£45–13–0$\frac{1}{4}$ *Ans.*

* Here I say 3 Pence is the $\frac{1}{4}$ of a Shilling in the second Line as well as in the first, because then $\frac{1}{4}$ will be the $\frac{1}{12}$; whereas, if I was to say 6*d* is the $\frac{1}{2}$ of a Shilling, then I must say $\frac{1}{4}$ is the $\frac{1}{24}$ of 6 Pence: Now 24 is not so easy to divide by as 12 is; so by bringing Sixpence into 2 Parts, the Work is a great deal more easy and natural.

		Bushels *d.*
6*d*	$\frac{1}{2}$	1753 6$\frac{1}{2}$ *Bushel*
$\frac{1}{2}$	$\frac{1}{12}$	876 – 6
		73 – 0$\frac{1}{2}$
	2|0	94|9 – 6$\frac{1}{2}$
		£47–9–6$\frac{1}{2}$ *Ans.*

		oz.
6*d*	$\frac{1}{2}$	1753 at 6 $\frac{3}{4}$ *oz.*
$\frac{3}{4}$	$\frac{1}{8}$	876 – 6
		109 – 6$\frac{3}{4}$
	2|0	98|6–0$\frac{3}{4}$
		£49–6–0$\frac{3}{4}$ *Ans.*

		lb. *d.*
6*d*	$\frac{1}{2}$	1753 at 7*lb.*
1*d*	$\frac{1}{6}$	876 – 6*d.*
		146 – 1*d.*
	2|0	102|2 – 7
		£51–2–7 *Ans.*

		Gallons
6*d*	$\frac{1}{2}$	1753 at 7$\frac{1}{4}$ *Gall.*
1*d*	$\frac{1}{6}$	876 – 6*d.*
$\frac{1}{4}$	$\frac{1}{4}$	146 – 1
		36 – 6$\frac{1}{4}$
	2|0	105|9–1$\frac{1}{4}$
		£52–19–1$\frac{1}{4}$ *Ans.*

6*d*	$\frac{1}{2}$	1753 *lb.* at 7$\frac{1}{2}$ *lb.*
1$\frac{1}{2}$	$\frac{1}{4}$	876 – 6
		219 – 1$\frac{1}{2}$
	2|0	109|5 – 7$\frac{1}{2}$
		£54–15–7$\frac{1}{2}$ *Ans.*

Ells

4d	$\frac{1}{3}$	1753 *Ells* at 7$\frac{3}{4}$
3d	$\frac{1}{4}$	584 – 4
$\frac{3}{4}$	$\frac{1}{4}$	438 – 3
		109 – 6$\frac{3}{4}$
	2|0	113|2 – 1$\frac{3}{4}$
		£56–12–1$\frac{3}{4}$ *Ans.*

Or you may say 6d. is $\frac{1}{2}$, 1d. is $\frac{1}{6}$, and $\frac{3}{4}$ is the $\frac{1}{8}$ of 6 Pence.

4d	$\frac{1}{3}$	1753 *Yards* at 8d.
4d		584 – 4
		584 – 4
	2|0	116|8 – 8
		£58–8–8 *Ans.*

Or you may say 6d. is $\frac{1}{2}$, and 2d. is $\frac{1}{3}$ of 6 Pence; or as 8d is $\frac{2}{3}$ of a Shilling, you may multiply by 3, and divide by 2.

6d	$\frac{1}{2}$	1753 *lb.* at 8$\frac{1}{4}$
2d	$\frac{1}{3}$	876 – 6
$\frac{1}{4}$	$\frac{1}{8}$	292 – 2
		36 – 6$\frac{1}{4}$
	2|0	120|5 – 2$\frac{1}{4}$
		£60–5–2$\frac{1}{4}$

4d	$\frac{1}{3}$	1753 *Pair* at 8$\frac{1}{2}$
4d	$\frac{1}{3}$	584 – 4
$\frac{1}{2}$	$\frac{1}{8}$	584 – 4
		73 – 0$\frac{1}{2}$
	2|0	124|1 – 8$\frac{1}{2}$
		£62–1–8$\frac{1}{2}$ *Ans.*

4d	$\frac{1}{3}$	1753 *Ells* at 8$\frac{3}{4}$
4d	$\frac{1}{3}$	584 – 4
$\frac{1}{2}$	$\frac{1}{8}$	584 – 4
$\frac{1}{4}$	$\frac{1}{2}$	73 – 0$\frac{1}{2}$
		36 – 6$\frac{1}{4}$
	2|0	127|8 – 2$\frac{3}{4}$
		£63–18–2$\frac{3}{4}$ *Ans.*

6d	$\frac{1}{2}$	1753 *lb.* at 9d
3d	$\frac{1}{2}$	876 – 6
		438 – 3
	2|0	131|4 – 9
		£65–14–9 *Ans.*

6d	$\frac{1}{2}$	1753 *Yards* at 9$\frac{1}{4}$
3d	$\frac{1}{2}$	876 – 6
$\frac{1}{4}$	$\frac{1}{12}$	438 – 3
		36 – 6$\frac{1}{4}$
	2|0	135|1 – 3$\frac{1}{4}$
		£67–11–3$\frac{1}{4}$ *Ans.*

Ells

6d ½ 1753 *Ells* at 9½

3d ½ 876 – 6
½ ⅙ 438 – 3
73 – 0½

2|0 138|7 – 9½

£69-7-9½ *Ans.*

6d ½ 1753 *lb.* at 9¾

3d ½ 876 – 6
¾ ¼ 438 – 3
109 – 6¾

2|0 142|4 – 3¾

£71-4-3¾ *Ans.*

6d ½ 1753 *Ells* at 10*d.*

4d ⅓ 876 – 6
584 – 4

2|0 146|0 – 10

£73-0-10 *Ans.*

6d ½ 1753 *oz.* at 10¼

3d ½ 876 – 6
1d ⅓ 438 – 3
¼ ¼ 146 – 1
36 – 6¼

2|0 149|7-4¼

£74-17-4¼ *Ans.*

6d ½ 1753 *lb.* at 10½

3d ½ 876 – 6
1½ ½ 438 – 3
219 – 1½

2|0 153|3 – 10½

£76-13-10½ *Ans.*

6d ½ 1753 *oz.* at 10¾

3d ½ 876 – 6
1½ ½ 438 – 3
¼ ⅙ 219 – 1½
36 – 6¼

2|0 157|0 – 4¾

£78-10-4¾ *Ans.*

6d ½ 1753 *oz.* at 11*d.*

4d ⅓ 876 – 6
1d ¼ 584 – 4
146 – 1

2|0 160|6 – 11

£80-6-11 *Ans.*

6d ½ 1753 *Ells* at 11¼
4d ⅓ 876 – 6
1d ¼ 584 – 4
¼ ¼ 146 – 1
36 – 6¼

2|0 164|3 – 5¼

£82-3-5¼ *Ans*

lb.

6*d*	$\frac{1}{2}$	1753 *lb.* at 11$\frac{1}{2}$
4*d*	$\frac{1}{3}$	876 – 6
1$\frac{1}{2}$	$\frac{1}{4}$	584 – 4
		219 – 1$\frac{1}{2}$
	2|0	167|9–11$\frac{1}{2}$
		£83–19–11$\frac{1}{2}$ *Anſ.*

		lb.
6*d*	$\frac{1}{2}$	1753 at 11$\frac{3}{4}$
4*d*	$\frac{1}{3}$	876 – 6
1$\frac{1}{2}$	$\frac{1}{4}$	584 – 4
$\frac{1}{4}$	$\frac{1}{6}$	219 – 1$\frac{1}{2}$
		36 – 6$\frac{1}{4}$
	2|0	171|6 – 5$\frac{3}{4}$
		£85-16-5$\frac{3}{4}$ *Anſ.*

		lb.
1*s.*	2|0	175|3 at 12 *d.*
		£87 – 13 *Anſ.*

And thus, *Tyro*, I have ſhewn you from one Farthing to a Shilling, how to take the Parts, ſo as to do any Sum for any Number of *lbs. Yards*, &c. You may by your own Practice take the Parts in what Manner you pleaſe, only remember this *ſtanding Rule*, That when you take the Parts of a Shilling, you muſt divide the Top Number by ſuch Parts; but when you take the Parts of any Part, you muſt divide ſuch a Part by the Number of Parts, and not the Top-line. Do you underſtand it?

Tyro. I do, Sir, very well; but pray, ſuppoſe the Price exceeds one Shilling, how muſt I do then?

Philo. That you will ſoon learn by the following CASE.

CASE

CASE 3.

When the given Price exceeds one Shilling, or 12 Pence, but is leſs than two Shillings; then let the top Line, or given Number, ſtand as it is given, without drawing any Line under it; for that is the Price or Value at one Shilling; then take the Parts, as before, out of the top Line, or given Number, and add the ſaid Parts and top Number together, you have the Anſwer in Shillings, Pence, and Farthings, which divide by 20, as before.

Examples *above Twelve Pence, and under Two Shillings.*

3*d*	$\frac{1}{4}$	1753 *lb.* at 15 *d.*
		438 – 3 *d.*
	2|0	219|1 – 3
		£109 – 11 – 3 *Anſ.*

Here you ſee that I let 1753 ſtand without drawing a Line, and that is of itſelf an Anſwer for 12 *d.* a *lb.* Then I ſay, as before, 3 *d.* is $\frac{1}{4}$, and I add theſe two together, muſt be the Price at 15 *d.* for 12 and 3 is 15.

6*d*	$\frac{1}{2}$	1753 *Ells* at 19 *d* $\frac{1}{2}$
1$\frac{1}{2}$	$\frac{1}{4}$	876 – 6 *d.*
		219 – 1$\frac{1}{2}$
	2|0	284|8 – 7$\frac{1}{2}$
		£142-8-7$\frac{1}{2}$ *Anſ.*

Examples *of other Numbers.*

6*d*	$\frac{1}{2}$	47 *Yds* at 21 *d.*$\frac{1}{2}$
3*d*	$\frac{1}{2}$	23 – 6 *d.*
$\frac{1}{2}$	$\frac{1}{6}$	11 – 9
		1 – 11$\frac{1}{2}$
	2|0	8|4 – 2$\frac{1}{2}$
		£4-4-2$\frac{1}{2}$ *Anſ.*

6d	$\frac{1}{2}$	*85 *Ells* at 22d. $\frac{1}{2}$
3d	$\frac{1}{2}$	42 - 6
1$\frac{1}{2}$	$\frac{1}{2}$	21 - 3
		10 - 7$\frac{1}{2}$
	2|0	15|9 - 4$\frac{1}{2}$
		£19-19-4$\frac{1}{2}$ *Ans.*

* 1 There is a Sort of *mechanical* Method of doing Sums, or casting up the Total of the Price of any Commodity, which is often used in Business by such as are not acquainted with taking the Parts according to the strict Order of this Rule.

A mechanical or customary Way of casting up any of the foregoing Examples, for those that cannot divide by the Parts.

Let us take the last *Example, viz.* 85 *Ells* at 22 *d.* $\frac{1}{2}$ *per* Ell.

Rule. Count how many Shillings, 6 Pences, Groats, Pence, or any other Denominations the given Number makes, and set the Products under one another, as in *Addition*, and add all together, you have the Answer.

Thus the last *Example* 85 *Ells at* 22 *d.* $\frac{1}{2}$ *per* Ell.

First,	85 Shillings	is	£4 - 5 -
	85 Six-pences		2 - 2 - 6
	85 Three-pences		1 - 1 - 3
	85 Pence		- 7 - 1
	85 Half-pence		- 3 - 6$\frac{1}{2}$
			£7 - 19 - 4$\frac{1}{2}$ as before.

Tyro. I heartily thank you, Sir, for these Observations.

Philo. I do it to serve you, take which Way you please; for that is best which is soonest understood, tho' it be a little deviating from the stated Rule itself. And now,

now, *Tyro,* we will proceed to the other Part of this Rule.

CASE 4.

Rule 1. When the given Price is above two Shillings, then (by *Table* 2) take such Shillings as even Parts of a £. and divide the given Quantity thereby; then take the Pence as Parts of a Shilling, and the Farthings as Parts of a Penny, dividing each Sum or Line by the Parts to which they belong Or,

Rule 2. Multiply the given Quantity by the Shillings, and then take the Parts for the Pence and Farthings, as in the last Cases; then add all together, and divide by 20, it is done.

		Yards
2*s*	$\frac{1}{10}$	125 at 2*s*. 8*d*. $\frac{1}{2}$ *Yd.*
6*d*	$\frac{1}{4}$	12 – 10*s*.
2*d*	$\frac{1}{3}$	3 – 2 – 6 *d*.
$\frac{1}{2}$	$\frac{1}{4}$	1 – 0 – 10
		– 5 – $2\frac{1}{2}$
		£16 – 18 – $6\frac{1}{2}$ *Ans.*

Here 2 *s*. is $\frac{1}{10}$ of a £. therefore I divide 125 by 10, and it gives £12 - 10*s*. the Price at 2 *s*. *per* Yard. Then 6 *d* is $\frac{1}{4}$th of 2 *s*. I therefore divide £12 · 10*s*. by 4, and it gives £3-2-6. Then 2 *d*. is $\frac{1}{3}$ of 6 *d*. I therefore divide £3 – 2 – 6 by 3, and it gives £ 1 and 10 Pence, the Price at 2 *d*. *per* Yard. *Lastly*, I say $\frac{1}{2}$ny is $\frac{1}{4}$ of 2*d*. and take the $\frac{1}{4}$ of £ 1 – 10 *d*. is 5 *s*. 2*d*. $\frac{1}{2}$ the Price at $\frac{1}{2}$ny a Yard. The Sum of all these is £16-18-6*d* $\frac{1}{2}$. *Ans.*

PROOF

PROOF *by the Second* RULE.

		Yards
d.		125 at 2*s.* 8*d.* $\frac{1}{2}$
6*	$\frac{1}{2}$	2
		250
		62 – 6*d.*
2*d*	$\frac{1}{3}$	20 – 10
$\frac{1}{2}$	$\frac{1}{4}$	5 – 2 $\frac{1}{2}$
		33|8 – 6 $\frac{1}{2}$
		£16-18-6$\frac{1}{2}$ as before

* Here I multiply 125 by 2, and it gives 250 Shillings, at 2*s.* a Yard. Then I ſay 6 *d.* is $\frac{1}{2}$ of a Shilling, therefore, I divide the top Line 125 by 2, (and not 250) and it gives 62*s.* 6*d.* and ſo for any other Sum; then I take the other Parts, as before directed, as by the Work appears.

Philo. Do you underſtand it?

Tyro. I do very well; but I like the laſt Way the beſt.

Philo. Take which you pleaſe, 'tis only Uſe that makes both eaſy.

		Ells
5*s*	$\frac{1}{4}$	417 at 5*s.* 10*d.*
d.		
10	$\frac{1}{6}$	104 – 5*s.*
		17 – 7 – 6*d.*
		£121 – 12 – 6 *Anſ.*

First, 5*s.* is $\frac{1}{4}$ of a £. I divide 417 by 4, gives £104 – 5*s.* then 10 Pence is $\frac{1}{6}$ of 5*s.* therefore I divide £104 - 5*s.* by 6, and find the Quotient £17, and 2 over, this 2 I call 2 Pounds, and the odd 5*s.* makes £2 - 5, or 45 Shillings; then I ſay the 6's in 45 is 7 Times, and 3 over; this I call 3 Shillings, and divide that alſo by 6, it gives 6 Pence.

PROOF.

PROOF *another Way.*

4d	$\frac{1}{3}$	417 *Ells* at 5s. 10d.
		5
4d	$\frac{1}{3}$	2085
		139
2d	$\frac{1}{2}$	139
		69 - 6d.
	2|0	243|2 - 6
		£121-12-6 as before

Here I multiply by 5, and it makes Shillings; then I say 4 Pence is $\frac{1}{3}$ of a Shilling, and take it out of the top Line 417: I say again 4 Pence is $\frac{1}{3}$, and set down the same; then 2 Pence is $\frac{1}{2}$ of 4 Pence, and having added all up, and divided by 20, I have the same Answer.

And now, *Tyro*, I shall set you a few Examples with Words at Length.

10s	$\frac{1}{2}$	57 Pieces at 12s 9d$\frac{1}{2}$
s. d.		
2-6	$\frac{1}{4}$	28 - 10 -
3d	$\frac{1}{10}$	7 - 2 - 6
$\frac{1}{2}$	$\frac{1}{6}$	- 14 - 3
		- 2 - 4$\frac{1}{2}$
		£36 - 9 - 1$\frac{1}{2}$ *Ans*

PROOF.

6d	$\frac{1}{2}$	57 Pieces at 12s 9d$\frac{1}{2}$
		12
		684
3d	$\frac{1}{2}$	28 - 6
$\frac{1}{2}$	$\frac{1}{6}$	14 - 3
		2 - 4$\frac{1}{2}$
		72|9 - 1$\frac{1}{2}$
		£36-9-1$\frac{1}{2}$ as before

10s.	$\frac{1}{2}$	185 Load at 18s 10d
4s.	$\frac{1}{5}$	92 - 10
4s.	$\frac{1}{5}$	37 -
8d	$\frac{1}{6}$	37 -
2d	$\frac{1}{4}$	6 - 3 - 4d.
		1 - 10 - 10
		£174 - 4 - 2 *Ans.*

PROOF.

6d	$\frac{1}{2}$	185 Load at 18s 10d
		18 multiply
4d	$\frac{1}{3}$	3330
		92 - 6
		61 - 8
	2|0	348|4 - 2
		£174-4-2 as above

And

And thus, *Tyro*, you may take which Method you please; but in the next *Case* you are confined to take the Parts according to *Table* 2.

CASE 5.

When the given Price of any Thing is more than 20 Shillings, or 1 Pound, and not so much as 2 Pounds, then let the given Quantity stand without drawing a Line under it, and that is the Price, at 1 Pound; then take the Parts for the Shillings and Pence, as in the last *Case*, and the Work is done.

EXAMPLES.

		Ells
10*s.*	$\frac{1}{2}$	45 at £1-12-6
2*s* 6*d*	$\frac{1}{4}$	22 - 10
		5 - 12 - 6
		£73 - 2 - 6 *Ans.*

Here I let 45 stand without drawing any Line under it, which is the Price at 1 Pound *per* Ell; then I take the Parts according to the Rule in the last *Case*, adding all together have £73 - 2 - 6 *Ans.*

		Tons
10*s.*	$\frac{1}{2}$	75 at £1-17-11$\frac{1}{2}$
5	$\frac{1}{2}$	37 - 10
2*s* 6*d*	$\frac{1}{2}$	18 - 15
5*d*	$\frac{1}{6}$	9 - 7 - 6
$\frac{1}{2}$	$\frac{1}{10}$	1 - 11 - 3
		- 3 - 1$\frac{1}{2}$
		£142 - 6 - 10$\frac{1}{2}$ *Ans.*

Here you see 75 Tons at £1 *per* Ton is £75, which I let stand without drawing any Line under it, and then I take the Parts for 17 *s.* 11 *d.* $\frac{1}{2}$, as you find in the Margin.

CASE

CASE 6.

When the given Price of the Commodity is above two Pounds, then multiply by the Pounds gives the Anſwer, for the Number of Pounds, and the Shillings and Pence and Farthings muſt be taken out of the Top, or given Number, as before directed.

EXAMPLE.

10s	$\frac{1}{2}$	37 *Load* at £3-16-9
		3
		111
5s	$\frac{1}{2}$	18 - 10 -
1s	$\frac{1}{5}$	9 - 5 -
6d	$\frac{1}{2}$	1 - 17 -
3d	$\frac{1}{2}$	- 18 - 6
		- 9 - 3
		£141 - 19 - 9 *Anſ.*

Here I multiply 37 by £3, which gives £.111, and then I ſay, 10 s. is $\frac{1}{2}$ of a £. and take it out of the Top £. 37, which is £.18 - 10s. then I ſay 5 Shillings is $\frac{1}{2}$ of 10, and take the $\frac{1}{2}$ of £18-10s which is £9 - 5s. and ſo I go on, taking the Parts as the Work plainly ſhews

One EXAMPLE *at large*.

		Hhds.
10s	$\frac{1}{2}$	15 at £12-18 and $\frac{3}{4}$
		12
		180
5s	$\frac{1}{2}$	7 - 10
2-6	$\frac{1}{2}$	3 - 15
6d	$\frac{1}{5}$	1 - 17 - 6
$\frac{3}{4}$	$\frac{1}{8}$	- 7 - 6
		- - 11$\frac{1}{4}$
		£193-10-11$\frac{1}{4}$ *Anſ.*

Here 15 Hhds. at £12 *per* Hhd. is £180; then I ſay 10 s. is $\frac{1}{2}$, and take the $\frac{1}{2}$ of £15, the top Number, which is £7-10s. and ſo I proceed, by taking the reſt of the Parts, ſaying, 5 Shillings is the $\frac{1}{2}$ of 10 Shillings, and take the $\frac{1}{2}$ of £7 - 10s, &c.

And

And now, *Tyro*, I think you have had ſufficient Inſtructions in this Rule, if you carefully obſerve them. However, that I may omit Nothing that may be uſeful to you in Buſineſs, there are ſome ſhorter Methods of caſting up Things than the Rule itſelf teaches; but this is according to the given Price, that is, when the given Price is juſt two Shillings, or when it is any even Number of Shillings, as in the two following *Caſes*.

CASE 7.

When the given Price is any even Number of Shillings, as 2, 4, 8, 14, 16, *&c.* then multiply the given Quantity by Half the even Number of Shillings, and cut off the firſt Figure in the Units Place with a Daſh of your Pen, or Pencil; then all the Figures to the Left-hand are Pounds, and the Figure you cut off in the Units Place being doubled, will be Shillings, and you have the Anſwer required.

EXAMPLES.

48 Yards at 4*s.* *per* Yard.

2 Here the Price is 4 Shillings *per* Yard, therefore I multiply the given Quantity

£9|6 48 by Half the Price, (*viz.* 2.) and it is

Anſ. £9–12*s.* 96; then I cut off the firſt Figure (*viz.* 6) and double it, which is 12 for the Shillings, and the Figure 9 is the Pounds; ſo is the Anſwer £9 – 12*s.* Again.

328 Ells at 12*s.* *per* Ell.

6 Here I multiply by 6, which is ½ the given Price, and cut off the firſt

£196|8 Figure, and double it for the Shil-

Anſ. £196–16*s.* ings, which is 16, and the Figures on the Left-hand of the Daſh are Pounds.

More

More EXAMPLES.

417 at 14 *s.*		Again,	695 Ells at 18 *s.*
7			9
£291|9	*Ans.* £291 - 18 *s.*		£625|5 *Ans.* 625–10 *s.*

CASE 8.

When the given Price is any even Number of Shillings, and you would know what Quantity of any Thing may be bought for any even Number of Pounds Sterling, then only add a Cypher to the given Pounds, and divide that Sum by Half the Number of the given Price, gives the Anſwer in Pounds Sterling.

EXAMPLES.

How many *lb.* of Tea, at 12 *s. per lb.* may I have for £36. *Anſ.* 60 *lb.*

£36 add a Cypher is 360

$\frac{1}{2}$ of 12 *s.* is 6) 60 *lb.* *Anſ.*

How many Gallons of Rum, at 18 *s. per* Gallon, may I have for £250.

£250 add a Cypher is 2500

$\frac{1}{2}$ of 8 *s.* is 4) 625 Gallons. *Anſ.*

Tyro. I like this very well, Sir; and it is not only eaſier, but much ſhorter than taking the Parts: But ſuppoſe there be Fractions after the given Number, how then?

Philo. Take ſuch *Fractional* Parts out of the given Price, and add it to the reſt of the Work, as by the following *Caſe.*

L CASE

CASE 9.

When the given Quantity, or Number, has *Fractional* Parts after it, then take such Parts out of the given Price, and place the Sum under the rest, and add all together. Or thus, (which may be easier) Multiply the Price by the *Numerator*, (or Top-figure) of the Fraction, and divide the Product by the Denomination (or Lower-figure) and you have the *Fractional* Value at once.

10*s*	$\frac{1}{2}$	15 $\frac{5}{8}$ Yards at 10 *s*.
	$\frac{5}{8}$	7 – 10
		6 – 3 for $\frac{5}{8}$ths
		£7 – 16 – 3 *Ans.*

Here I say $\frac{1}{8}$th of 10*s*. is 1*s*. 3*d*. therefore, $\frac{5}{8}$ths is 5 Times as much, *viz.* 6*s*. 3*d*. Or thus, I multiply 10*s*. the Price, by 5, the Numerator, which is 50, and divide by 8, the Denominator, I have 6*s*. 3*d*. the Value at $\frac{5}{8}$ths *per* Yard.

	3 $\frac{7}{8}$ Yards at 18 *s*.
	9*
	2 – 14 –
$\frac{7}{8}$	15 – 9
	£ 3 – 9 – 9 – *Ans.*

* Here the Price being an even Number of Shillings, I multiply by $\frac{1}{2}$ of it, *viz.* 9, (according to the Rule in the last *Case*) and double the first Figure, which is £2 – 14 *s*. Then for $\frac{7}{8}$ I multiply the Price, *viz.* 18 *s*. by 7, and divide by 8, and it is 15 *s*. 9 *d*. And thus may many Sums in this *Case*, as well as in others, be done in a very short and easy Manner, by Care and Observation.

Tyro. I see it plainly, Sir; and now, if you please, I would be glad to have a Notion of working *Weight*, *viz.* *Tons*, *Cwts.* *qrs.* *lbs.* &c.

Philo. I am as ready to instruct you.

SECTION II.

Of WEIGHT.

Tyro. WHAT is the Nature of working this Rule?

Philo. By taking the Parts, as before directed; as you will plainly see by and by: But first of all the two following Tables ought to be learned perfectly.

TABLE 1.

Even Parts of a Ton.

C. qrs.		
10 – 0	is	$\frac{1}{2}$ a *Ton.*
5 – 0		$\frac{1}{4}$
4 – 0		$\frac{1}{5}$
2 – 2		$\frac{1}{8}$
2 – 0		$\frac{1}{10}$
1 – 1		$\frac{1}{16}$
1 – 0		$\frac{1}{20}$

TABLE 2.

Even Parts of an Cwt.

qrs. lbs.		
2 – 0	is	$\frac{1}{2}$ an *Cwt.*
1 – 0		$\frac{1}{4}$
16		$\frac{1}{7}$
14		$\frac{1}{8}$
8		$\frac{1}{14}$
7		$\frac{1}{16}$

Having got the above *Tables* pretty readily by Heart, the Rule is,

RULE.

Multiply the given Tons, or Hundreds, by the given Price, and if there be any Parts, as Shillings and Pence, work with them as in the foregoing Examples: This being done, take the Parts for the odd Weight out of the given Price, and place it under the rest, and the Work is done.

But this is better understood by an Example or two.

What comes 7 *C.* 3 *qrs.* to, at £2 – 6 *s. per Cwt.*

2

5 *s.*	$\frac{1}{4}$	14
1	$\frac{1}{5}$	1 – 15
2 *qrs.*	$\frac{1}{2}$	– 7
1	$\frac{1}{2}$	1 – 3
		– 11 – 6
		£17 – 16 – 6

Here I multiply 7 by 2, and it gives £14; then I ſay 5 *s.* is $\frac{1}{4}$, and take the $\frac{1}{4}$ of £7, the top Number; then I ſay 1 *s.* is the $\frac{1}{5}$, and take the $\frac{1}{5}$ of £1 – 15 *s.* This being done, I begin with the odd Weight, ſaying, 2 *qrs.* is $\frac{1}{2}$ of an *Cwt.* and I take the $\frac{1}{2}$ of the Price £2 – 6 *s.* and it is £1 – 3 *s.* then 1 *qr.* is $\frac{1}{2}$ of 2 *qrs.* I take the $\frac{1}{2}$ of £1 – 3 *s.* which is 11 *s.* 6 *d.*

What coſt 14 *Ton*, 16 *C.* 3 *qrs.* 21 *lb.* at £12–16 *per Ton?*

12

10 *s.*	$\frac{1}{2}$	168	The Value at £12 *per Ton.*
5 *s.*	$\frac{1}{2}$	7 – –	Ditto at 10 *s. per Ton.*
1 *s.*	$\frac{1}{5}$	3 – 10 –	Ditto at 5 *s. per Ton.*
2 *qrs.*	$\frac{1}{2}$	– 14 –	Ditto at 1 *s.*
1 *qr.*	$\frac{1}{2}$	6 – 5 –	The $\frac{1}{2}$ of £12–10 the Price
14 *lb.*	$\frac{1}{2}$	3 – 2 – 6	The $\frac{1}{2}$ of £6 – 5.
7 *lb.*	$\frac{1}{2}$	1 – 11 –	The $\frac{1}{2}$ of £3 – 2 – 6.
		– 15 – 7$\frac{1}{2}$	The $\frac{1}{2}$ of £1 – 11 – 3.
		£190–18–4$\frac{1}{2}$ *Anſ.*	

I have here, *Tyro*, ſet againſt every Line what the Value is, and where it is taken out of, that you may be the better grounded in the Work: For remember the Money is taken out of the given Weight, and the odd Weight is taken out of the given Price, as you were told in the Rule.

Tyro. I ſee the Nature of it, Sir, plainly.

Philo. Then I ſhall leave you a few Queſtions for you to work, or prove at Leiſure.

QUESTIONS

QUESTIONS *to exercise the Learner.*

1. What cost 125 *lb.* of Indigo, at 14*d.*–$\frac{3}{4}$ *per lb.*? *Ans.* £7 – 13 – 7$\frac{3}{4}$.

2. What is gained in £476, at 4*s.* 10*d.* $\frac{1}{2}$ *per* £. *Ans.* £116 and 6*d.*

3. What is the Value of 47 Load, at £3 – 15 – 6$\frac{1}{2}$ *per* Load? *Ans.* £177 – 10 – 5$\frac{1}{2}$.

4. What cost 9 Ton, 15 *C.* 3 *qrs.* 27 *lb.* of Iron, at £14 *per* Ton? *Ans.* £137 – 3 – 10$\frac{1}{2}$.

DIALOGUE X.

SECTION I.

SIMPLE INTEREST.

Tyro. SIR, you have given me great Satisfaction in the Rules of *Practice*, and now I should be glad to be informed something concerning *Interest*. Pray what is it?

Philo. *Interest* is Money that arises from a certain Sum lent out at so much *per Cent. per Annum*; and is a Consideration allowed by the Borrower to the Lender.

Tyro. What do you mean by *per Cent. per Annum*?

Philo. *Per Cent.* signifies 100 Pounds, and *per Annum* signifies a Year, or 12 Calendar Months.

Tyro. How is Interest found?

Philo. *Interest* may be performed by the *Rule of Three Direct*, (as you may see by *Example* 1 following) but in some Cases it is done easier and shorter by *Practice* and Custom, and that is the Reason that *Interest* has a Place and Title in all Books of Arithmetic by itself.

Tyro. Pleaſe to give an Example by the *Rule of Three*, and prove it by the ſhort cuſtomary Way.

Philo. I will.

EXAMPLE.

What is the Intereſt of £175–10*s.* for a Year, at £5 *per Cent. per Annum?*

£. £. £. *s.*
If 100——be——5 what is 175 – 10
20 20

2000 3510
5

2000)17550(8£.
16000

1550
20

2000)31000(15 Shillings
2000

11000 *Anſ.* £8–15–6.
10000

1000
12

2000)12000(6*d.*
12000

0

Here you ſee I am obliged to make my *firſt* and *ſecond* Number of one Name, ſo that according as the Sum is, it requires a great many Figures; but by the other Method you ſpare all this Trouble; which pray obſerve.

Second

Second METHOD. CASE I.

Multiply the Principal, or given Sum, by the Rate *per Cent.* and cut off two Figures towards the Right-hand, (which is the ſame, obſerve, as dividing by 100) and the Figures towards the Left are Pounds Intereſt: This done, multiply the Figures cut off to the Right-hand by 20, and take in the odd Shillings, and cut off two Figures, as before, and the Figures on the Left-hand are Shillings: Then multiply the Remainder by 12, and cut off two Figures, and the Figures on the Left-hand are Pence. *Laſtly*, multiply by 4, and cut off as before, you have the Farthings.

Thus the above Example is done as under.

```
        £.    s.
        175 - 10
               5
      ----------
     £8)77 - 10
        20
      ----------
   s. 15)50
        12
      ----------
    d 6) 00     Anſ. £8-15-6 as above.
```

Tyro. Indeed this is very ſhort to what the firſt Work is.

Philo. Then pray obſerve the Rule, for all the following Examples are performed after the ſame Manner; and remember, that cutting off two Figures towards the Right-hand is the ſame as dividing by 100.

Quest. 2. What is the Interest of £515 – 10*s.* for 1 Year, at £4 *per Cent. per Annum?*

£515 – 10
4 *per Cent.* Multiply

£20)62
20

*s.*12)40
12

*d.*4) 80
4

*qrs.*3)20

Anf. £8 – 12 – $4\frac{3}{4}$ $\frac{20}{100}$, or $\frac{2}{10}$ths of a Farthing.

Quest. 3. What is the Interest of £1050 for 1 Year, at £3 *per Cent. per Annum?*

£1050
3 *per Cent.*

£31)50
20

*s.*10) 00 *Anf.* £31 – 10*s.*

Tyro. You need not give me any more Examples of this Sort: But suppose the Money be lent for more than 1 Year, how then?

CASE

CASE 2.

When the given Rate *per Cent.* is an even Part of £100, then divide the Principal by that even Part, and the Quotient is the Answer at once.

Take *Example* 1, *viz.* £175 - 10*s.* at £5 *per Cent.*

Here £5 being $\frac{1}{20}$ of £100, I only divide £175-10*s.* by 20, and it is done.

£.	*s.*
2|0)17|5	- 10*
£8 - 15	- 6 *Anſ.*

* *Note*, After I divide 175 by 20, I ſay, the 20th Part of 10*s.* is 6 Pence.

Queſt. 4. What is the Intereſt of £345 - 17 - 6, at £25 *per Cent.?*

Here £25 being $\frac{1}{4}$th of £100, I divide the Principal £345 - 17 - 6 by £4, and it is done.

£.	*s.*	*d.*
4)345	- 17	- 6
£86	- 9	- $4\frac{1}{2}$ *Anſ.*

CASE 3.

When the Principal is put out for Years and Months, find the Interest for the Years first, and take the Months as even Parts of a Year, according to the Rules of *Practice.*

Quest. 5. What is the Interest of £175 - 10*s.* for 3 Years 9 Months, at £5 *per Cent. per Annum?*

£175 - 10		
5 *per Cent.*		
£8) 77 - 10		
20	Interest for 1 Year is	£8 - 15 - 6
		3
*s.*15) 50		
12		26 - 6 - 6 - for 3 Yrs
	6 Mths $\frac{1}{2}$ a Year	4 - 7 - 9
*d.*6)00	3 Mths $\frac{1}{2}$	2 - 3 - 10$\frac{1}{2}$
	Ans.	£32 - 18 - 1$\frac{1}{2}$

A Prac-

A Practical QUESTION.

Quest. 6. A Gentleman left his Niece by Will £558 − 15 Shillings, to be paid her when she came to Age. with Interest, at £4 *per Cent.* Now she came to Age in 5 Years, 9 Months, and 3 Weeks: What has she got to receive in all, Principal and Interest?

£558 − 15*s.*
4 *per Cent.*

£22)35	Interest for 1 Year	£22 − 7*s.*
20		5 Years
*s.*7)00	6 Mths $\frac{1}{2}$ Year	111 − 15
	3 Mths $\frac{1}{2}$	11 − 3 − 6*d.*
	2 Weeks $\frac{1}{6}$	5 − 11 − 9
	1 Week $\frac{1}{2}$	− 18 − 7$\frac{1}{2}$
		9 − 3$\frac{3}{4}$
		£129 − 18 − 2$\frac{1}{4}$ Int.
		558 − 15 − Leg.

The Legacy and Interest is £688 − 13 − 2$\frac{1}{4}$

Tyro. Sir, I thank you for these two useful Examples: And now I would only ask this one Favour, and that is, how am I to tell the Interest of any Sum for any Time, at 3$\frac{1}{2}$, 4$\frac{1}{2}$ 4$\frac{3}{4}$, or the like *per Cent.*

Philo. It is something more difficult than the other, but an Example or two, with your due Observation, will make it very easy.

CASE

CASE 4.

When the given Rate *per Cent.* is not even Pounds, but is $2\frac{1}{2}$, $1\frac{3}{4}$, $4\frac{1}{2}$, or the like, then multiply the Principal, or given Sum, by the even Pounds, and take the $\frac{1}{2}$, or $\frac{1}{4}$, or $\frac{3}{4}$ of the said Principal, or given Sum, and add to that Product; then cut off two Figures, and proceed in all Respects as before.

Quest. 7. What comes the Interest of a Bond of £685 to, at £$4\frac{1}{2}$ (that is, £4 – 10*s.*) *per Cent. per Annum?*

```
                685
                  4
s.          ─────────
10   | ½ |  2740
     |   |   342 – 10
            ─────────
        £30)82 – 10
             20
        ─────────
        s.16)50
             12
        ─────────
         d.6)00
```

Here I multiply by 4, then for $\frac{1}{2}$ *per Cent.* which is 10 Shillings, I say 10*s.* is $\frac{1}{2}$, as in *Practice*, and take $\frac{1}{2}$ of 685, and add to the other, it is £3082 – 10*s.* then I cut off two Figures thus, 30|82 and proceed as before, I find it £30 – 16 – 6.

Quest. 8. Lent £500 upon a Mortgage, to receive Interest at £4¾ (*viz.* £4 – 15*s.*) *per Cent.* till it was paid off: Now the Mortgage was paid off 3 Years, 8 Months after: I demand the Interest due to me?

s.		£.				
		500	Interest for 1 Year is £23 – 15 –			
		4	Multiply by		3	
10	½	2000	6 Months	½	71 – 5 – for	3 Yrs
5	½	250	2 Months	⅓	11 – 17 – 6	6Mths
		125			3 – 19 – 2	2Mths
		£23)75			£87 – 1 – 8 *Ans.*	
		20				
		*s.*15)00				

Tyro. I understand all these Examples very well; but suppose the Interest be for less than a Year, how then am I to find it?

Philo. Very easily.

CASE 5.

When the Interest of any Sum is to be found for less than a Year, *viz.* for 1, 2, 3, 4, or 10 Months, or for Months and odd Days, then first find the Interest for 1 Year, and take the Parts of that Year's Interest according to the given Time: Thus, if it be 6 Months Interest, take the Half of the Year's Interest; if 9 Months, take ¾; if 3 Months, take ¼; and for the odd Weeks, or Days, take the Parts of those Months.

Quest.

Quest. 9. What is the Intereſt of £175 – 10*s.* for 8 Months, at £5 *per Cent. per Annum?*

175 – 10	Intereſt for 1 Year is			£8 – 15 – 6
5				
£8)77 – 10	Then ſay, 6 Mths		$\frac{1}{2}$	4 – 7 – 9 for 6M
20	2 Mths		$\frac{1}{3}$	1 – 9 – 3 for 2M
*s.*15)50				£5 – 17 –
12				
*d.*6)00				

Here you ſee I take the Half of 1 Year's Intereſt, which is £4 – 7 – 9 for 6 Months; then I ſay, 2 Months is $\frac{1}{3}$ of 6 Months, and take the $\frac{1}{3}$ of £4 – 7 – 9, and add both together, is £5 – 17 for 8 Months.

Tyro. I am ſatisfied, Sir.

Philo. This is the beſt Way for calculating Intereſt in general, and will be near enough for common Practice, ſhould there be Weeks or Days; for it is only taking the Parts for ſuch Weeks and Days, as was ſaid before.

Tyro. But ſuppoſe the Intereſt be put out for ſuch a Number of Days as cannot well be taken in their even Parts, how then?

RULE 1.

Philo. Firſt, Find the Intereſt for one Year, as before; then ſay, If 365 Days give ſo much, what will ſo many Days give? Thus: Suppoſe the Intereſt for one Year be £17 – 10 – 10, and it was required to find the Intereſt for 73 Days, I ſay,

If 365 Days give £17–10–10, what will 73 Days give? *Anſ.* £3 – 10 – 2.

RULE

RULE 2.

Bring the Principal, or Money lent out, into Pence, and multiply those Pence by the Number of Days the Sum is put out at, or continues out; then if the Rate *per Cent.* it be put out at be £5, divide by 7300; and if it be £6 *per Cent.* divide by 6083, you have the Answer in Pence. There are many other Ways to find the Interest for Days; but I would recommend the first Rule of these two to the Learner, as it serves for all Rates *per Cent.* and is most certain.

SECTION II.

Of Assurances, Brokerage, *or* Commission.

Tyro. WHAT is *Assurance, Brokerage, or Commission?*

Philo. Assurances, or *Insurances*, are of various Sorts. An *Assurance* is when any Person agrees with another at a certain Rate *per Cent.* to insure his Life for such a Time, or his Ship upon a Voyage, from the Dangers of the Seas, or his House or Goods from Fire. *Brokerage* is an Allowance of so much *per Cent.* given to *Brokers*, or Persons employed in buying and selling Stocks, or transacting Business between Buyer and Seller: And *Commission* is also an Allowance of so much *per Cent.* for buying or selling any Sort of Commodity, by the Order of any other Person, *&c.*

Tyro. Then I perceive these are all cast up the same as the Interest of Money is.

Philo. They are so, only Interest is so much *per Cent. per Annum*; but *Brokerage* is cast up only at so much *per Cent.* ready Money, without any Regard to Time. Of these in their Order.

Of

1. *Of* ASSURANCES.

Quest. 1. What comes an Assurance of £580 to, at £10$\frac{3}{4}$ *per Cent.*?

		£.
		580
		10
s.		
10	$\frac{1}{2}$	5800
5	$\frac{1}{2}$	290
		145
		£62)35
		20
		s. 7)00

Here I multiply by 10, then I take the Parts out of the Top, or £580, and add all together, and cut off two Figures, (which is dividing by £100) and proceed as in Interest, by multiplying the Remainder by 20, *&c.*

Anf. £62 – 7*s.*

Quest. 2. Shipped for *Jamaica* Goods to the Value of £1200, upon which I made an Assurance, at £7$\frac{5}{8}$ths *per Cent.* what does it come to?

	£.
	1200
	7
$\frac{4}{8}$ is $\frac{1}{2}$	8400
$\frac{1}{8}$ is $\frac{1}{4}$	600
	150
	£91)50
	20
	s. 10)00

Here I multiply by 7, then I say for the Fraction 4 Eighths is $\frac{1}{2}$, that is, the $\frac{1}{2}$ of $\frac{8}{8}$ths (for 8 Eighths is equal to 1 whole Integer) and take the $\frac{1}{2}$ of the top Number; then I say $\frac{1}{8}$th is $\frac{1}{4}$ of $\frac{4}{8}$ths; then I add all together, and cut off two Figures, as before, *&c.* and find the Answer £91 – 10*s.*

2. *Of*

2. *Of* Brokerage *and* Commission.

Tyro. You need not give me any more Examples; for I see the Work is the same, tho' under different Titles, or Names.

Philo. It is so; but still when the *per Cent.* is Shillings it may be a little difficult to you; therefore I will give you an Example or two.

Quest. 3. What is the Commission of a *Broker* for buying or selling £520 Stock, at Half a Crown *per Cent.*

Rule. Multiply the Money by the Shillings, and take the Parts for the Pence as in *Practice*; then add all together, and cut off two Figures to the Right-hand, and those towards the Left are your Answer in Shillings.

```
            £520
               2
          ------
6d | ½ |    1040
       |     260
          ------
          s 13)00
```

Ans. 13 Shillings

Quest. 4. What is my Commission on £1500, at 7*s.* *per Cent.*?

```
             7
        ------
Shill   105)00
```

Answer £5 – 5*s.*

Another Way.

Cut off two Figures of the given Sum, and multiply the Remainder by 20, 12, and 4, gives the Answer, at £1 *per Cent.* then take the Parts of the Sum of £1 *per Cent.* as in *Practice*, you have your Answer.

Quest.

Quest. 5. What is my Commission on £1252 – 10*s.* at 7 *s.* 6 *d. per Cent.*

£12)52 – 10*s.*		At £1 *per Cent.* it is	£12 – 10 – 6
20			
*s.*10) 50	Then, 5*s.*	$\frac{1}{4}$	3 – 2 – 7$\frac{1}{2}$
12	2-6	$\frac{1}{2}$	1 – 11 – 3$\frac{3}{4}$
*d.*6)00		*Ans.*	4 – 13 – 11$\frac{1}{4}$

3. *Compound* INTEREST.

Tyro. What is *Compound Interest ?*

Philo. Compound Interest is called Interest upon Interest ; that is, the Interest of the Principal, and the Interest of the Interest added together, is the *Compound* Interest. But it being seldom used without it be in purchasing of Annuities, *&c.* and being very tedious to calculate, is done with more Ease by *Decimal Fractions.*

Tyro. But I should be glad you would give me a little better Notion of it.

Philo. Suppose I put out £100 for 3 Years, at £5 *per Cent. Compound* Interest, what does it come to ?

First, I find the Simple Interest for 1 Year is £5 ; then the second Year I am to count what the Interest of £105 is, and find it £5 – 5*s.* This I add to the last Principal £105, and it makes £110 – 5*s.* Then I see what is the Interest of £110 – 5*s.* and find it £5 – 10 – 3 for the third Year. Then I add these different Interests together, *viz.* £5. £5 – 5*s.* and £5 – 10 – 3, and it makes £15 – 15 – 3, the *Compound Interest* for three Years on £100, at £5 *per Cent.* And thus for any Number of Years, at any Rate *per Cent.*

SEC-

SECTION III.

Of REBATE, *or* DISCOUNT.

Tyro. WHAT do you mean by *Rebate*, or *Discount?*

Philo. Discount is when a Sum of Money, which is to be paid at any Time to come, is ſatisfied by paying of it down in preſent Money; which preſent Money being put out after the ſame Rate *per Cent.* and for the ſame Time, will be increaſed to the Debt or Sum that was firſt to be paid.

Tyro. Explain this a little fuller in other Words.

Philo. Suppoſe a Perſon owes me 100 Guineas, *viz.* £105 to be paid in a Year, or 12 Months to come, how much preſent Money will ſatisfy the Debt? *Anſ.* £100 preſent Money will ſatisfy a Debt of £105 due 12 Months hence; becauſe £100 put out to Intereſt 12 Months will be £5.

There are ſeveral Methods of performing this Rule of *Diſcount*; but as it is beſt done by *Decimal Fractions*, I ſhall give only this one general Rule.

A General RULE.

1. Add the Intereſt of £100 for the given Time to £100, and make this your *firſt Number*; then place £100 only for your *ſecond Number*, and the given Debt your *third Number*, and the Anſwer will be the preſent Money that will ſatisfy the Debt due 12 Months to come; then take this preſent Money from the Debt, and the Remainder is the *Rebate* for 12 Months.

2. Having thus found the Rebate for one Year, if the Time be more or leſs than 12 Months, take the Parts by the Rule of *Practice* accordingly.

3. Thus

3. Thus it appears that the *first Number* is always known according to the Rate *per Cent.* for one Year, as by the following Table.

For at £3 *per Cent.* the *first Number* will be 103, &c.

£ 3 *per Cent.* 103	These observe are *first* Numbers according to the *Rebate per Cent.* for one Year, £100 is your *second*, and the Debt your *third*, and the Answer is the present Money to be paid down.
4 ———— 104	
5 ———— 105	
6 ———— 106	
7 ———— 107	
8 ———— 108	

Quest. 1. What present Money will pay a Draught or Note of Hand of £368 – 4*s.* due 3 Months hence, allowing Rebate at £5 *per Cent. per Annum?*

£. £. £. *s.*
If 105 —— 100 —— 368 – 4. *Ans.* £350-13-4 which taken out of the Debt £368-4*s.* leaves £17-10-8 the Discount for one Year.

1. *Rule.* Bring the *first* and *third* Number into Shillings; then multiply the *third* by your *second*, and divide by your *first*, you have £350, and 14 remains, which also multiply by 20, and divide by your *first Number*, you have 13 Shillings, and 7 remains, which multiply by 12, and dividing by the same *first* Number, you have 4*d.*

Note of Hand		£368 – 4 –
Present Money		350 – 13 – 4
Discount is		17 – 10 – 8 for 1 Year
3 Months	$\frac{1}{4}$	4 – 7 – 8 *Ans.* for 3 Months.

Here

Here you see for one Year the *Discount* is £17-10-8, and as 3 Months is ¼th of a Year, I take the ¼th of that Sum, which is £4-7-8 *Ans.*

Note, Had the Note been drawn for 15 Months, that is, 1 Year, and 3 Months; then add £4 - 7 - 8, the *Discount* of 3 Months to £17 - 10 - 8, which is £21 - 18 - 4, the *Discount* of £368 - 4*s.* for 15 Months.

An EXAMPLE *for Practice.*

What present Money will pay a Debt of £500, due 3 Years, 4 Months hence, allowing *Rebate,* at £6 *per Cent. per Annum? Ans.* £416 - 13 - 4. *Rebate* £83-6-8. For by the Table your *first* Number will be £106 for one Year, your *second* £100, and the *third* the Debt. And, for Proof, find the Interest of £416-13-4 for three Years, and four Months, at £6 *per Cent.* and add to it £416 - 13 - 4, you will have £500 the Debt itself.

And by these Examples you may find the *Discount* at any Rate *per Cent.* and for any Time, by observing the foregoing Directions.

Tyro. I see the Manner of working this Rule very plainly.

Philo. Then I will give you a Notion of another useful Rule, *viz.*

SECTION IV.

EQUATION *of* PAYMENTS.

Tyro. WHAT do you mean by *Equation of Payments?*

Philo. Equation of Payments is when a certain Sum of Money becomes due at different Times, or is to be paid

paid at different Payments, and it is agreed between the Debtor and Creditor to ſet, or pitch upon a certain Time for the Payment of the Whole, without any Damage or Loſs to either.

Tyro. This is very pretty as well as uſeful: Pray give me the Rule for working Queſtions of this Sort.

RULE.

Multiply the Sum of each particular Payment by the Time it is to be paid in; then add the ſeveral Products together, and divide the Sum by the whole Debt, and the Quotient is the *Equated*, or juſt Time for the Payments of the Whole.

Queſt. 1. A Merchant buys Goods to the Value of £140, £30 of which is to be paid in one Month, £40 in 3 Months, £20 in 4 Months, and £50 in 6 Months; but it is agreed upon an *equated* Time to pay the Whole at once; I demand the *equated*, or juſt Time of Payment at once.

I ſet down each Payment, and the Time right againſt it, and multiply the Money by the Time, and ſet the Products of each right againſt them, as follows.

£30 multiplied by 1 Mth is £30
40 ———— by 3 Mths is 120 add
20 ———— by 4 Mths is 80
50 ———— by 6 Mths is 300

Debt 140)530(3 Months
420
———
110
30 * *
———
140)3300(23 Days
280
———
500
420
———
80

Anſ. 3 Months, 23 Days.

** *Note,* I multiply by 30, the Days in a Calendar Month, according to the Custom of Business, because 12 such Months are reckoned to the Year.

Quest 2 A Merchant bought Goods to the Value of £500, upon the following Conditions, *viz.* $\frac{1}{4}$th to be paid in two Months, and the Remainder in 6 Months; I demand the *equated* Time to pay the Whole at one Payment?

First, $\frac{1}{4}$ of £500 is	£125	multiplied by 2 Mths	£250
The Remainder is	375	multiplied by 6 Mths	2250
Debt	£500		5|00)25|00
			Ans. 5 Mths

Now £2500 divided by the Debt 500 is 5 Months for the Answer, and thus for any other Question. Do you understand it?

Tyro. There can be nothing easier to apprehend than this.

QUESTIONS *to exercise this* RULE.

3. A Father left his Son £600, to be paid by his Executor as follows, $\frac{1}{3}$ in 3 Months, $\frac{1}{3}$ in 4 Months, and $\frac{1}{3}$ in 8 Months; but he being very troublesome to the Executor, and he as willing to be rid of him, they agree upon a Time for the Payment of the Whole at once. The *equated* Time is demanded. *Ans.* 5 Months.

4. *A* owes *B* £2000 to be paid 3 Months hence; but *A* agrees to pay him £1200 down, provided he will give him a longer Time for the Payment of the Remainder. The Question is, how long Time *B* ought to give him to pay the other £800 in? *Ans.* $7\frac{1}{2}$ Months.

Tyro.

Tyro. What other Rules are there in Common *Arithmetic?*

Philo. Several others, as *Alligation Medial*, and *Alternate*, *Single* and *Double Position*, *Composition* of *Medicines*, *Arithmetical* and *Geometrical Progression*, &c. but these being not so much required in Business, (or at least may be done by the *Rule of Three Direct*) I shall give a little Notion of the two last, because it may be of Service to you in Case your Fancy should turn to any Part of the *Mathematical* Studies.

DIALOGUE XI.

SECTION I.

Of ARITHMETICAL PROGRESSION.

Tyro. WHAT do you mean by *Arithmetical Progression?*

Philo. *Arithmetical Progression* is by some called *Comparative Arithmetic*, because in a Series of Numbers one is compared with another, in Order to know what Ratio or Proportion one bears to the other; that is, in what Manner they differ. and how much, and that Difference is always equal in Numbers that are continued.

OBSERVATION.

1. Let us take any Numbers that differ alike from one another: Thus. 3, 6, 9, 12, 15, *&c.* differ by 3, called the common Excess, Difference, or *Ratio*. Also, 1, 9, 17, 25, 33, are Numbers in *Arithmetical Progression*, whose *Ratio*, or common Difference, is 8.

2. In

2. In any Series of Figures in *Arithmetical Progression*, when the Number of Places is odd, *viz.* 3, 7, 11, 15, 19, or the like, the Double of the middle Figure, or Place, is equal to the Sums of the first and last Figure; thus, 2, 6, (10) 14, 18. The Double of the middle Term 10 is equal to the Sum of the first and last Number, *viz.* 20. So 3, 8, 13, (18) 23, 28, 33. The middle Term 18 doubled is equal for the Sum of 3 and 33, *viz.* 36.

Tyro. How many Cases are there in this *Rule?*

Philo. Six; but *two* of them will be sufficient for your Purpose in working Questions in general, or to give you a true Notion of the Nature of the Rule itself.

CASE 1.

The Number of Places, or Terms, and the *Ratio*, or common Excess, being given to find that last Number.

Multiply the Number of Places less by 1, by the *Ratio*, or common Excess, and to that Product add the first Number, and that Sum will be equal to the last Number.

1. Let the first Number be 3, Number of Places 7, common Excess 5, what is the last Number?

Here the Number of Places is 7, therefore, I count them for 6, (which is less 1) and the *Ratio*, or common Excess, is 5, now 5 Times 6 is 30; then I add the first Number, *viz.* 3, and it is 33, the last Number, and so on, if the Places were ever so many.

2. Let the Number of Terms be 121, the first Number 5, and the common Excess, or *Ratio*, 9; I demand the last Number?

Here the Number of Places less by 1 is 120, which multiplied by 9, the *Ratio*, gives 1080, to which add the first Number 5, gives 1085, the last Number. And this you may prove by setting them down thus, 5, 14, 23, 32, 41, till you have 121 Places, and your last Number will be 1085.—But how tedious is this! Since you see the last Number is so easily found.

A QUESTION *for Exercise.*

A Traveller sets out, and the first Day went 6 Miles, the second Day 9, increasing every Day's Journey 3 Miles, and travelled 61 Days; how many Miles did he go the last Day? *Ans.* 186 Miles. See the next *Case*.

CASE 2.

The Extremes, that is, the first and last Number, and the Number of Terms being given to find the Aggregate, or total Sum of all the Series of Numbers,

Add the first and last Number together, and multiply that Sum by half the Number of Places, and the Product is the Sum of all the Series. Or in Case the Number of Terms be odd, then add the first and last Numbers together, and multiply that Sum by the Number of the Terms, and divide that Product by 2, and you have the Total of all the Places.

Thus, in the last Question concerning the Travels, the first Number is 6, the last Number 186 Miles, and the Places 61. Therefore, by the Rule, add the first Number 6, and the last Number 186 together, and it is 192, which I multiply by 61, and it is 11712, and dividing by 2, I have 5856, the Miles he went in all in 61 Days.

A QUESTION

A QUESTION *for Exercise.*

Quest. 2. Suppose 100 Stones be placed in a straight Line, at a Yard distant from each other, and a Person undertakes to pick up one at a Time, and bring it back to the Place where he first set out; how far will he have gone when he has picked up the Whole.

Here the Number of Places are 100, and as the Stones are but one Yard from each other, the common Excess is but 1, and therefore, the last Number is also 100. But here you are to consider, the Man is to come back with every Stone; therefore, when he fetches the first Stone in coming back, he goes in 2 Yards to put the first Stone, therefore, 2 is your first Number, and by the same Rule 200 will be your last Number.

Last Number	200
First Number	2
	202
Half of the Number of Places	50
He goes in all	10100 Yards,

He goes in all 10100 Yards, which reduced into Miles, is $5\frac{1}{2}$ Miles, and 420 Yards, which wants but 20 Yards of $5\frac{3}{4}$ Miles.

Quest. 3. Suppose Stones were laid one Yard asunder, in a right Line, for one Mile in Length, and to be picked up one by one, coming back with one at a Time; how far would the Person go that performs it. *Ans.* 1761 Miles.

SECTION II.

Of GEOMETRICAL PROGRESSION.

Tyro. I AM mightily pleaſed with what you have ſhewn me; but pray what is *Geometrical Progreſſion*, and wherein does it differ from the other?

Philo. Geometrical Progreſſion, or *Proportion*, is when Numbers differ from one another, by the like *Ratio*, or Reaſon, as in *Arithmetical Progreſſion*, only with this Difference, that the former is the Effect of *Addition*, and here of *Multiplication*, all the Numbers having one common Multiplier. As 2, 4, 8, 16, differ by double Reaſon, or the *Ratio* is 2; for twice 2 is 4, twice 4 is 8, *&c.* So alſo, 1, 7, 49, 343, *&c.* Here the *Ratio* is 7, for 7 Times 1 is 7, and 7 Times 7 is 49, *&c.* So that you ſee it is *Multiplication.*

Tyro. I thank you Sir: What elſe pray?

NOTE I.

Philo. Any three Numbers that differ in *Geometrical Progreſſion*, the Product of the *Extremes*, that is, the Product of the *firſt* and *laſt* Number, is equal to the Square of the *Mean*, that is, equal to the middle Number multiplied by itſelf.

Let 4, 12, and 36 be the 3 Numbers, whoſe *Ratio* is 3, that is, each is 3 Times more than the foregoing Number; then will the Product of the Extremes 4 and 36 be equal to the Square of 12, the *Mean*, *viz.* equal to 144. So alſo, 2, 16, and 128. Here 128 multiplied by 2 is equal to 16 multiplied by 16 equal to 256.

NOTE 2.

Any 4 Numbers that differ in *Geometrical Proportion*, either continued or interrupted (provided the Interruption or breaking off be between the *ſecond* and *third* Number)

Number) the Product of the *Means* is equal to the Product of the *Extremes*; that is, the Product of the *first* and *fourth* is equal to the Product of the *second* and *third* Numbers.

Let the 4 Numbers be 3, 12, 48, and 192, whose *Ratio* is 4. Here 192 multipled by 3, the *first* Number, is equal to 48 by 12, *viz.* equal to 576.

Again, Suppose the Numbers be interrupted, as 5, 30, 448, and 2688. Here the *second* Term is 6 Times more than the *first* Term, and the *fourth* Term 6 Times more than the *third*: Therefore, 2688 multiplied by 5 is equal to 448 multiplied by 30.

Note, This Mark (∺) stands for *Geometrical Progression.*

NOTE 3.

The *Ratio* of any Numbers in ∺ is found by dividing any Consequent by its Antecedent; that is, dividing any Number by the foregoing Number. Thus, the *Ratio* of the last Numbers is found by dividing 30 by 5, or 2688 by 448, which gives 6, the *Ratio.*

Tyro. I understand this very well; but in a long Series of Numbers, how am I to find the last Number?

Philo. This is very easily done, and as you have not the Rule in many, or, at least, have it but for certain *Ratio*, or Difference of Numbers, I shall give you one standing Rule, be the *first* Number and the *Ratio* what it will.

CASE 1.

To find the last Number in any Series in ∺. Having the *first* Number and *Ratio* given, set down your *first* Number, and multiply it by the *Ratio*, and that Product again by the *Ratio*, or common Difference, and thus go on for 5 or 6 Terms, at Pleasure; then multiply any

of thoſe Places by itſelf, and divide the Product thereof by the *firſt* Number, and it will be the Double of that Number, wanting one Place. Thus, Suppoſe you multiply the 6th Place by itſelf, and divide by the *firſt* Number, the Quotient will be the 11th Place; then, if you multiply the 11th Place by itſelf, and divide by the *firſt* Number, the Quotient will be the 21ſt Place, which is the Double of 11, wanting 1.

☞ *N. B.* When the firſt Term is Unity, or 1, there is no Occaſion to divide; for having multiplied by the *Ratio* a few Times, as before directed (ſuppoſe as far as the 6th Place) this Term multiplied by itſelf will be the Product of the Double of Terms wanting 1, as was ſaid before.

Tyro. I am obliged to you, Sir; but how ſhall I find the Sum of all the Series?

Philo. By the next Caſe.

CASE 2.

The Ratio, *(or Common Difference) and the laſt Number being given, to find the Aggregate, or total Sum of all the Series,*

1. Multiply the laſt Term, or Number, by the Common Difference, or *Ratio,* and from that Product take the *firſt* Number; then divide the Remainder by the Common Difference, leſs 1, and the Quotient will be the Sum of all the Series. Or,

2. Multiply the *ſecond* and laſt Term together; then multiply the *firſt* Term into itſelf, and take that Product from the Product of the *ſecond* and laſt Term; then divide the Remainder the *ſecond* Term, leſs 1, the *firſt* Term will give the Sum of all the Series.

Tyro. Pleaſe to give me one Example.

Philo. I will give you a practical Queſtion to exerciſe both Caſes.

Queſt.

Quest. A cunning Jockey had a fine Gelding, to which a Gentleman took a particular Fancy; and after many Words had paſſed between them, the Jockey agreed to ſell him to the Gentleman for the Price his Shoes would come to at one Farthing for the firſt Nail, and to double the Price every Nail: Now the Number of Nails in the Gelding's Shoes were 28, I demand then what he was ſold for at this Rate?

Now obſerve, *Tyro*, Here the common Exceſs is 2. (that is, a Farthing a Nail doubled) now to find the laſt Number by *Caſe* 1, double a few Places, ſuppoſe as far as the 7th, which will be 64; then multiply 64 by itſelf, *viz.* 64, you have 4096, the 13th Place, which doubled, gives the 14th Place, *viz.* 8192. This multiplied by itſelf gives the 27th Place, which doubled, gives the 28th, or laſt Place, *viz.* 134217728 Farthings; then proceed according to *Caſe* 2, you will find the Sum of all the Series to be 268435455 Farthings, which is £279620 5*s.* 3$d\frac{3}{4}$, a Sum too large for the ignorant Purchaſer. And had there been but 4 Nails more in his Shoes (*viz.* 32) he would have come to £4473924 5*s.* *

* It is no eaſy Taſk to make ſome Perſons believe the Truth of the Increaſe of Figures in *Geometrical Progreſſion* in theſe Queſtions; but ſuppoſe a Servant was to agree with his Maſter to ſerve him thirty Years, for 1 ſingle Wheat Corn the firſt Year, for the ſecond Year 10, for the third 100, and ſo on; the Produce of the Wheat would be more than all the Ships in *England* could carry away at once; and the Money for his Wages would be more than all the Land could pay, ſold at 20 Years Purchaſe for ever.

SECTION III.

Of PERMUTATION, *or Variety of Changes.*

Tyro. I Imagine this is much after the same Manner as *Progression*; is it not?

Philo. This shews the Increase of Numbers as well as the other; but does not teach you to find the Sum of all, only their different Variations, or Changes, as follows.

Multiply every Number together, that is, the *first* by the *second*, and that Product by the *third* Figure, and so on, till you have gone through all the given Numbers; so is the last Product the Variety of Changes.

EXAMPLE.

I demand the Changes that may be rung on 12 Bells, or the different Position 12 Persons may sit at Table. *Ans.* 479001600.

☞ *Note*, This Sign (×) signifies, that all Numbers between which it stands are to be multiplied continually one into the other, thus: Take the 12 Bells, and multiply the *first* by the *second*, you have two Changes upon two Bells; multiply this by the *third* Bell, you have 6 on three Bells; multiply this Product by 4, or the *fourth* Bell, you have 24 Changes, *&c.* as follows.

Thus, $1\times2\times3\times4\times5\times6\times7\times8\times9\times10\times11\times12$ will produce 479001600 Changes, or different Positions; which you may prove very easily at Leisure by *Multiplication* only*.

* Notwithstanding the Changes on 8 Bells may be rung out in a few Hours; yet the Changes on 12 (allowing 10 Changes in a Minute) will take 91 Years, 26 Days; and to add to the Incredibility of this Increase, two Bells more, *viz.* 14, would take up 16575 Years to ring the Changes through. See Mr. *Ward*, p. 85.

Tyro.

Tyro. I thank you for giving me a ſhort Hint of theſe Things, which I perceive the Nature of very plainly: And now, pray, what will you inſtruct me in next?

Philo. There are two or three Rules, ſuch as the *Rule of Falſe*, *Allegation*, *Alternate*, *Compoſition of Medicines*, which are not material in Buſineſs, and therefore for Want of Room muſt be omitted, and the more neceſſary Part, *viz.* *Vulgar Fractions*, be treated of in their Stead. And here I beg you would take Care and make yourſelf Maſter of *Vulgar Fractions*, they being very neceſſary in almoſt every Branch of Life, and the very Foundation of *Decimals*.

DIALOGUE X.

SECTION I.

Of Notation of VULGAR FRACTIONS.

Tyro. WHAT do you mean by *Notation?*

Philo. *Notation*, like *Numeration*, ſhews you how to note, write down, or expreſs any *Fraction*.

Tyro. What is a *Vulgar Fraction?*

Philo. It is a broken Number, or a Part, or Parts of an Integer, or whole Number, and conſiſts of two Parts, *viz* the *Numerator*, which always ſtands a top, and the *Denominator*, which always ſtands under it, or below. Thus, $\frac{4}{5}$, $\frac{3}{4}$, $\frac{11}{12}$. Here 4, 3, and 11 are the *Numerators*, and 5, 4, and 12 the *Denominators*.

Tyro. How many Sorts of *Vulgar Fractions* are there?

Philo. Three, *viz.* *Firſt*, *Simple*, *Single*, or *Proper Fractions* (for theſe are all one.) *Secondly*, *Improper*; and *thirdly*, *Compound Fractions*.

Tyro. What is a *Simple Fraction*, or how is it known?

Philo. *Simple Fractions* have their *Numerators* leſs than their reſpective *Denominators*. Thus, $\frac{1}{2}$, $\frac{3}{4}$, $\frac{5}{9}$, $\frac{14}{87}$, *&c.* are all *Simple Fractions*.

Tyro. What is an *Improper Fraction?*

Philo. *Improper Fractions* have their *Numerators* larger than their *Denominators*. Thus $\frac{4}{3}$, $\frac{9}{5}$, $\frac{87}{14}$, $\frac{127}{2}$, *&c.* are *Improper Fractions*.

Tyro. What are *Compound Fractions?*

Philo. *Compound Fractions* are *Fractions of Fractions*, compounded, or joined together by the Word *of*. Thus, $\frac{2}{3}$ of $\frac{3}{5}$, or $\frac{5}{4}$ of $\frac{3}{4}$ of $\frac{11}{12}$ are *Compound Fractions*, and are thus read, 2 Thirds of 3 Fifths, or 3 Fourths of 5 Sixths of 11 Twelfths of an *Integer*, or *Whole Number.*

Tyro. I underſtand you, Sir; but this is very difficult to tell ſurely.

Philo. You have Nothing to do with this at preſent; you will know it by and by.

Tyro. What do you mean by a *Mixt Number?*

Philo. A *Mixt Number* is a *whole* Number with a Fraction after it. Thus, 14 $\frac{2}{5}$, and 147 $\frac{5}{8}$ are *Mixt Numbers*.

Tyro. I underſtand you; but how am I to find the Value of different *Fractions*.

Philo. By *Reduction*, which is always learned firſt, becauſe you can't *add*, *ſubtract*, *multiply*, or *divide*, till the Fractions are firſt reduced to their proper Order: But before you proceed any farther, it will be proper to learn the following Signs, or Characters, by Heart, ſo as to know what they ſignify; which will be a great Help to you.

Of the Signs uſed in Vulgar Fractions.

This (=) is the Sign of Equality, and ſignifies, that the Numbers before it are equal to thoſe after it. Thus, 5 and 2=7 is thus read, 5 and 2 is *equal to* 7.

This Mark (+) is the Sign of *Addition*, and ſignifies all the Numbers are to be added together. Thus, 2+6+7=15: That is, 2 *more* 6 *more* 7, or 2 added to 6 and 7, is *equal* to 15.

This

This (—) is the Sign of *Subtraction*, and signifies the Number after it is taken, or is to be taken out of the Number before it. Thus, $15-7=8$, that is, 7 taken, or subtracted from 15, is *equal to* 8.

This (×) is the Sign of continual Multiplication. Thus, $4\times5\times7=140$; *viz.* 4 multiplied by 5, and that Product by 7, makes 140.

This (÷) is the Sign of *Division*, and signifies the Number before it is to be divided by the Number that follows it. Thus, $56\div8=7$, that is, 56 divided by 8 is *equal to* 7.

SECTION II.

Reduction of VULGAR FRACTIONS.

CASE I.

To reduce a Mixt Number *to an* Improper Fraction.

MULTIPLY the whole Number by the Denominator of the Fraction, and take in the Numerator besides; then place the Denominator under the Product, and it is done.

Reduce $57\frac{3}{5}$ to an *Improper Fraction.*

$$\begin{array}{l} 57\frac{3}{5} \\ \underline{\;\;5} \\ 288 \\ \overline{\;\;5\;\;} \end{array} \quad \textit{Anf.}\ \frac{288}{5}$$

Reduce $1753\frac{11}{12}$ to an *Improper Fraction* *Anf.* $\frac{21047}{12}$.

CASE

CASE 2.

To reduce an Improper Fraction *to a* Whole *or* Mixt Number.

Divide the *Numerator* by the *Denominator*, and if any Thing remains, place it for a new *Numerator* over the *Denominator*.

Reduce $\frac{288}{5}$ to a *Mixt Number*?

$$\begin{array}{r} 5)288 \\ \hline 57\frac{3}{5} \end{array} \quad \textit{Anf.}$$

Reduce $\frac{21047}{12}$ to a *Mixt Number*? *Anf.* $1753\frac{11}{12}$.

CASE 3.

To reduce or make a Whole Number into an Improper Fraction.

Multiply the Whole Number by any Figure at Pleafure, and place the Product over the Figure you multiplied by, and you have an *Improper Fraction* equal to the given *Whole Number*.

Reduce 14 to an *Improper Fraction*, whofe Denominator muft be 9? *Anf.* $\frac{126}{9}$.

Here becaufe it fays 9 muft be the Denominator, I multiply 14 by 2, and it is 126, which I place over the 9, and it is done. *Anf.* $\frac{126}{9}$.

NOTE

NOTE 1.

To exprefs any *Whole Number* Fraction-wife, it is only putting Unity, or 1 under it. Thus, 14, 26, 490, *&c.* will be $\frac{14}{1}$, $\frac{26}{1}$, $\frac{490}{1}$, *&c.* Remember this, for it is very ufeful.

NOTE 2.

Every *Improper Fraction* is more than an Unit, or 1, and every *Simple Fraction* is lefs than Unity, or 1. Thus, the *Simple Fraction* $\frac{3}{4}$ of a £. Sterling, is but 15 Shillings: but $\frac{4}{3}$ of a £. Sterling is £1, and $\frac{1}{3}$ over; for if you divide 4 by 3, it is 1, and $\frac{1}{3}$, that is, £1 – 6 – 8.

NOTE 3.

When the Numerator and Denominator are alike, the Fraction is equal to a Whole Number. Thus, $\frac{4}{4}$ is 1, or $\frac{25}{25}$ is equal to 1; becaufe the Numerator divided by the Denominator produces 1.

CASE 4.

To reduce a Compound Fraction *to a* Simple *one, of the fame Value.*

Multiply all the Numerators together for a new Numerator, and all the Denominators for a new Denominator.

☞ *N. N.* fignifies *New Numerator*, and *N. D. New Denominator*, and *C. D. Common Denominator*; which pray remember.

1. Reduce $\frac{2}{5}$ of $\frac{3}{4}$ of $\frac{5}{8}$ to a *Simple Fraction?* *Anf.* $\frac{30}{160}$.

For $2\times3\times5=30$ *N. N.* and $5\times4\times8=160$ *N. D.*

That

That is, 2 multiplied by 3, and that Product by 5, is equal to 30 *N. N.* and 5 multiplied by 4, and that Product by 8, is equal to 160 *N. D.* *Anſ.* $\frac{30}{160}$.

☞ *Note*, When there are Cyphers in the Numerator and Denominator, then cut them off, and the *Fraction* is ſtill the ſame. Thus, in the foregoing Anſwer the *Fraction* is $\frac{30}{160}$, *viz.* $\frac{3}{16}$. So $\frac{4000}{7000}$ is only $\frac{4}{7}$.

2. Reduce $\frac{3}{5}$ of $\frac{5}{6}$ of $\frac{7}{8}$ of $\frac{11}{12}$ to a *Simple Fraction*. *Anſ.* $\frac{1155}{2880}$.

CASE 5.

To reduce a Fraction *to its loweſt Terms, that ſhall be equal to the original given* Fraction.

Divide the Numerator and Denominator by any Figure that will divide them without any Remainder; ſo ſhall the laſt Quotients be a New Numerator, and a New Denominator equal to the given Fraction.

1. Reduce $\frac{72}{120}$ into its loweſt Terms? *Anſ.* $\frac{3}{5}$.

Diviſors, 2 6 2

$\frac{72}{120}\Big|\frac{36}{60}\Big|\frac{6}{10}\Big|\frac{3}{5}$ *Anſ.* $\frac{3}{5}=\frac{72}{120}$. So alſo $\frac{168}{448}$ is $=\frac{3}{8}$, which you may prove by dividing the Numerator and Denominator by any Figures that will divide them both, as was ſaid before.

Note, There is another Way to reduce a Fraction to its loweſt Terms at once, and that is by finding a common Meaſurer.

To find a common Meaſurer.

Divide the Denominator by the Numerator, and if any Thing remains, divide the laſt Diviſor by ſuch Remainder, and if any Thing again remains, divide the laſt

laſt Diviſor thereby: Thus go on till Nothing remains, and your laſt Diviſor is the *Common Meaſurer*, or Number, that will divide the Numerator and Denominator at once into their loweſt Terms.

1. Reduce $\frac{168}{448}$ into its loweſt Terms. *Anſ.* $\frac{3}{8}$.

```
                 168)448(2
                     336
                     ———
                     112)168(1
                         112
                         ———
Common Meaſurer           56)112(2
                             112
                             ———
                               0
```

Here I divide the *Denominator* 448 by the *Numerator* 168, and 112 remains; then I divide 168, the laſt Diviſor, by that 112, and 56 remains; *laſtly*, I divide 112 by 56, and 0 remains: So is 56 the *Common Meaſurer*, that will divide both at one Work.

```
56)168(3 N. Numerator    56)448(8 N. Denominator.
   168                      448
   ——                       ——   Anſ. 3/8 = 168/448.
   0                        0
```

2. Reduce $\frac{512}{1280}$ to its loweſt Terms. *Anſ.* $\frac{2}{5}$.

CASE 6.

To reduce Fractions of different Denominators to Fractions of the ſame Value, having one common Denominator.

Firſt, Multiply all the Denominators together for a common Denominator; then begin with the firſt Numerator, and multiply it into all the Denominators, except its own Denominator: Do thus with all the other Numerators, multiplying them into all the Denominators except their own; ſo will theſe Products be *New* Numerators, which muſt be placed over the *Common* Denominator,

nominator, and each *Fraction* will be equal to *that* Fraction whose Numerator you multiplied into the Denominators.

1. Reduce $\frac{2}{3}$, $\frac{3}{5}$, and $\frac{5}{8}$ to Fractions, having one *Common Denominator*.

First, I multiply all the Denominators together, and it makes 120 for a *C.* Denominator. That is, $3\times5\times8=120$ *C. D.* Then I begin with the Numerator 2, that is, $2\times5\times8=80$ *NN.* Then the Numerator $3\times3\times8=72$ *NN.* And *lastly*, $5\times5\times3=75$ *NN.* These New Numerators I place over the *C.* Denominator, and the Work is done. Thus, $\frac{80}{120}=\frac{2}{3}$ for 80 is $\frac{2}{3}$ of 120. Also, $\frac{72}{120}=\frac{3}{5}$ and $\frac{75}{120}=\frac{5}{8}$.

2. Reduce $\frac{3}{4}$, $\frac{5}{6}$, $\frac{7}{8}$ and $\frac{4}{5}$ to Fractions having one *C.* Denaminator. *Ans.* $\frac{720}{960}=\frac{3}{4}$, $\frac{800}{960}=\frac{5}{6}$, $\frac{840}{960}=\frac{7}{8}$ and $\frac{768}{960}=\frac{4}{5}$.

CASE 7.

To reduce Fractions *of one Name or Denomination to another.*

1. ASCENDING.

When a *Fraction* is to be reduced from a less to a greater Denomination, then make the given *Fraction* into a Compound *Fraction*, by considering how many of the *Less* make one of the *Greater* Denomination; then reduce this *Compound Fraction* to a simple one, and it is done.

1. Reduce $\frac{1}{4}$ of a Penny to the Fraction of a £. Sterling. *Ans.* $\frac{1}{960}$£.

Here, because 12 Pence make 1 Shilling, and 20 Shillings a £. I say, $\frac{1}{4}$ of $\frac{1}{12}$ of $\frac{1}{20}$, which reduced to a *Simple Fraction* by multiplying the Numerators together

ther for a *N. N.* and all the Denominators for a *N. D.* gives $\frac{1}{960}$ of a £$=\frac{1}{4}$ of a Penny.

2. Reduce $\frac{3}{4}$ of a Farthing to the Fraction of a Guinea. *Ans.* $\frac{3}{4032}$, *viz.* $\frac{3}{4}$ of $\frac{1}{4}$ of $\frac{1}{12}$ of $\frac{1}{21}=\frac{3}{4032}$ *Ans.*

2. Reduce $\frac{1}{4}$ of a *lb.* to the Fraction of a Ton. *Ans.* $\frac{1}{8960}$.

2 DESCENDING.

When the *Fraction* is to be brought from a *greater* to a *less* Denomination, then make of it a *Compound Fraction*, as before; descending from the *great* to *lesser* Denomination: Then multiply every Denominator continually by the Numerator of the given *Fraction*, (except its own Denominator) and place the Product over the Denominator of the said given *Fraction*, you have the Answer.

N. B. This *Case* is a Proof to the last.

1. Reduce $\frac{1}{960}$ of a £. Sterling to the Fraction of a Penny? *Ans* $\frac{240}{960}$, or $\frac{1}{4}$. For $\frac{1}{960}$ of $\frac{1}{20}$ of $\frac{1}{12}$. Now the Numerator 1 multiplied into the Denominators 20 and 12, is$=$240, which I place over the Denominator 960, thus, $\frac{240}{960}$ *Ans.*

2. Reduce $\frac{3}{4032}$ of a Guinea to the Fraction of a Farthing *Ans.* $\frac{3024}{4032}$. For it is $\frac{3}{4032}$ of $\frac{21}{1}$ of $\frac{12}{1}$ of $\frac{4}{1}$. Now $3\times21\times12\times4=3024$ *NN.*

CASE

CASE 8.

To find the Value of a Fraction *in* Money, Weight, *or* Measure.

Multiply the Numerator of the Fraction by the next nearest Part belonging to the Integer itself, and divide by the Denominator; then multiply the Remainder by the next nearest Part of the Integer, and divide by the same Divisor, or Denominator, and thus go on till you have gone thro' all the Parts of the Integer, and the Quotients will be your Answer.

1. What is the Value of $\frac{26}{30}$ of a £. Sterling? *Ans.* 17*s.* 4*d.*

26 *Numerator* 20 3|0)52|0 17*s.* 10*d.* 12 3|0)12|0 4*d.*	Here I multiply the Numerator 26 by 20, the Shillings in a £. and divide by the Denominator 30, gives £17, and 10 over, which I multiply by 12, and divide again by 30, gives 4 Pence; therefore I find $\frac{26}{30}$ of a £. to be 17*s.* 4*d.*

2. What is the $\frac{15}{216}$ of a Moidore? *Ans.* 1*s.* 10*d.* $\frac{1}{2}$, as by the following Work.

15 *Numerator*	
27 *multiply*	
216) 405 (1 *s.*	
216	
189	
12	
216)2268(10 *d.*	
216	
108	
4	
216) 432 (2 *qrs.*	
432	
0	

Here I multiply the Numerator 15 by 27, the Shillings in a Moidore, and divide by the Denominator, gives 1 Shilling, and 189 over, which I multiply by 12, and divide by 216, as before, and so I go on, as appears by the Work, and find $\frac{15}{216}$ of a Moidore to be 1 *s.* 10 *d.* $\frac{1}{2}$.

Anf. 1 *s.* 10 *d.* $\frac{1}{2}$.

Tyro. I see the Nature of it plainly; and like this *Case* very well; for it is diverting as well as improving.

Philo. You are to proceed the same in *Weight* and *Measure*; therefore, I shall only set you a few Questions for Practice to try at Leisure.

3. What is the $\frac{324}{972}$ of a Ton? *Anf.* 6 *C.* 2 *qrs.* 18 *lbs.* 10 *oz.* 10 *dr.* $\frac{648}{972}$.

4. What is the $\frac{14}{112}$ of a Barrel? *Anf.* $4\frac{1}{2}$ Gallons.

5. What is the $\frac{150}{225}$ of a Mile? *Anf.* 1173 Yards, 1 Foot.

6. What is the $\frac{14}{16}$ of an Acre? *Anf.* 3 Roods, 20 Rods.

7. What is the $\frac{5}{12}$ of a Year (allowing 365 Days) *Anf.* 152 Days, 2 Hours.

SECTION III.

ADDITION of VULGAR FRACTIONS.

Tyro. HOW are *Vulgar Fractions* added together?

Phil. Very easily, by this one Rule, *viz.* All *Compound Fractions* must be reduced to *Simple* ones, and all Fractions of different Denominators, to a *Common* Denominator; then add all the Numerators together, and their Sum plac'd over the *Common* Denominator, is the Answer; and if it be an *Improper* Fraction at last, then reduce it to a *Mixt* Number, and the Work is done.

1. Add $\frac{2}{11}$ $\frac{1}{11}$ $\frac{3}{11}$ and $\frac{4}{11}$ together. *Ans.* $\frac{10}{11}$.

Here being one *Common* Denominator to all the Fractions, I only add the Numerators together, and the Work is done. *Ans.* $\frac{10}{11}$.

2. Add $\frac{25}{27}$ $\frac{14}{27}$ and $\frac{19}{27}$ together. *Ans.* $\frac{58}{27}=2\frac{4}{27}$.

Here I find the Sum of all the Numerators to be 58, which I place over the Denominator 27; but being an *Improper* Fraction, I divide 58 by 27, and have for *Answer* 2 and $\frac{4}{27}$.

3. Add $\frac{2}{3}$ $\frac{3}{5}$ and $\frac{5}{8}$. together. *Ans.* $\frac{227}{120}$.

Here the *Fractions* having different Denominators, I reduce them (by *Case* 6) to a common Denominator, and find them to be $\frac{80}{120}$, $\frac{72}{120}$, and $\frac{75}{120}$. Then I add these Numerators together, and find them 227. So the *Ans.* is $\frac{227}{120}=1\frac{107}{120}$.

4. Add

4. Add $\frac{2}{3}$ of $\frac{3}{5}$ and $\frac{1}{2}$ of $\frac{3}{8}$ together. *Anſ.* $\frac{141}{240}$.

Firſt, $\frac{2}{3}$ of $\frac{3}{5}$ is $=\frac{6}{15}$, and $\frac{1}{2}$ of $\frac{3}{8}=\frac{3}{16}$. Now $\frac{3}{16}$ and $\frac{6}{15}$ reduced to a *CD* is $\frac{45}{240}$, and $\frac{96}{240}$, which added together is $\frac{141}{240}$. *Anſ.*

5. Add £14 $\frac{3}{5}$ £19$\frac{2}{3}$ £47 $\frac{5}{8}$ and £100 together. *Anſ.* £181 $\frac{107}{120}$, or 17*s.* 10*d.*

6. What muſt I add to £54 $\frac{2}{3}$, and 19 $\frac{3}{5}$ to make it £100? *Anſ.* 25 $\frac{11}{15}$.

SECTION IV.

Subtraction *of* Vulgar Fractions.

Tyro. HOW is *Subtraction of Fractions* performed?

Philo. By the ſame Rule as in *Addition*, firſt reducing all *Compound* to *Simple*, and all to a *Common* Denominator; thus, *ſubtract* the Numerator of the *leſs* Fraction from the Numerator of the other, and place the Difference over the Denominator, is the Anſwer.

From	$\frac{14}{29}$		From	£67 $\frac{21}{47}$
Take	$\frac{11}{29}$		Take	18 $\frac{15}{47}$
Difference	$\frac{3}{29}$	*Anſ.*	*Anſ.*	49 $\frac{6}{47}$
Proof	$\frac{14}{29}$		Proof	67 $\frac{21}{47}$

Here in both theſe Examples I take the Numerator of the *leſs* Fraction from the Numerator of the top, or *greater* Fraction, and place the Difference over the Denominator. Then I prove the Work, as in common *Subtraction*, by adding the Numerator of the Difference to the Numerator of the leſs *Fraction*, and it gives the Numerator

tor of the top Fraction. And thus for all Examples of this Sort.

Tyro. I underſtand you very well, Sir; but ſuppoſe the Numerator of the Fraction to be ſubtracted be larger than the Numerator of the Fraction I am to take it out of, how am I to do then?

Philo. This is eaſy enough: For when you cannot take the lower Numerator out of the top Numerator, then take it out of the common Denominator, and to that Difference add the top Numerator, and place it over the Denominator for the true Difference; only pray remember this is called *borrowing*, as in common *Subtraction*, and you muſt carry one to the next Figure for ſo doing.

2. Lent	$134\frac{11}{24}$	is=£	134-11-8	*The* PROOF *by common* Subtraction.
Received	$95\frac{18}{24}$	is=	95-15-	
Due	$38\frac{20}{24}$	*Anſ.* is=£	38-16-8	
Proof	$134\frac{14}{24}$	Proof £	134-11-8	

3. From $\frac{2}{3}$ of $\frac{3}{5}$ take $\frac{1}{2}$ of $\frac{3}{8}$. That is, from $\frac{6}{15}$ take $\frac{3}{16}$. Now $\frac{6}{15}$ is $\frac{96}{240}$ and $\frac{3}{16}$ is $\frac{45}{240}$. Then I take $\frac{45}{240}$ from $\frac{96}{240}$ and there remains $\frac{51}{240}$. *Anſ.*

4. From 1 take $\frac{4}{11}$ *Anſ.* $\frac{7}{11}$. For I make an *Improper* Fraction equal to 1, which has a Denominator equal to the Fraction to be ſubtracted, *viz.* $\frac{11}{11}$ is $=1$. Then $\frac{7}{11}$ from $\frac{11}{11}$ remains $\frac{4}{11}$. And thus for any other Example.

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SECTION V.

MULTIPLICATION *of* VULGAR FRACTIONS.

Tyro. HOW is *Multiplication* performed?

Philo. The Fractions muſt be reduced to *Simple* ones, as before directed, and *Mixt* Numbers to *Improper* Fractions. Then the Rule is, Multiply the Numerators together for a new Numerator, and the Denominators together for a new Denominator, and the Work is done.

1. Multiply $\frac{4}{7}$ by $\frac{3}{6}$. *Anſ.* $\frac{12}{42}$. For $4\times3=12$ *N. N.* $7\times6=42$ *N. D.*
2. Multiply $\frac{247}{6}$ by $\frac{4}{9}$. *Anſ.* $\frac{988}{54}=18\,\frac{16}{54}$.
3. Multiply 4*d.* $\frac{1}{2}$ by 4*d* $\frac{1}{2}$. *Anſ.* 20*d.* $\frac{1}{4}$.

Firſt, I reduce $4\,\frac{1}{2}$ to an *Improper* Fraction, which is $\frac{9}{2}$; therefore, I multiply $\frac{9}{2}$ by $\frac{9}{2}$. *Anſ.* $\frac{81}{4}=20\frac{1}{4}$, as before.

4. Multiply £4 $\frac{3}{8}$ by £2. Here £4 $\frac{3}{8}=2\frac{35}{8}$, and £2 is expreſſed in Fractions $\frac{2}{1}$; therefore, multiply $\frac{35}{8}$ by $\frac{2}{1}$. *Anſ.* $\frac{70}{8}=$ £8 $\frac{6}{8}$, *viz.* £8. 15.

5. Multiply $\frac{2}{3}$ of $\frac{5}{8}$ by $\frac{3}{7}$ of $\frac{1}{5}$, that is, $\frac{10}{24}$ by $\frac{3}{35}$. *Anſ.* $\frac{30}{840}=\frac{3}{84}$. And thus may any Sum be multiplied by another, with more Exactneſs than by any other Rule, though not ſo eaſy as *Decimal Fractions.*

SECTION VI.

DIVISION *of* VULGAR FRACTIONS.

Tyro. HOW is *Division* of Fractions performed?

Philo. First, Reduce all *Compound* to *Simple* Fractions, and all *Mixt* Numbers to *Improper* Fractions, as before directed: Then the Rule is, Multiply the Numerator of the Dividend into the Denominator of the Divisor, for a new Numerator, and the Numerator of the Divisor (or Fraction you divide by) into the Denominator of the Dividend for a new Denominator, and you have the Answer.

1. Divide $\frac{8}{19}$ by $\frac{5}{12}$. *Ans.* $\frac{96}{95} = 1\frac{1}{95}$. Here I multiply 8 into 12, which is 96, for a new Numerator, and 5 into 19, which is 95, for a new Denominator, which is $\frac{96}{95}$. Here you see the Answer is an *Improper* Fraction; but if you change the Fractions, that is, if $\frac{5}{12}$ were to be divided by $\frac{8}{19}$, then the Answer would be $\frac{95}{96}$, which is a *Simple* Fraction.

Note, This Character ($\div$) signifies *Division*, or that the Number is divided by what follows it.

2. Divide £47 $\frac{1}{2}$ of $\frac{2}{3}$ by $\frac{2}{3}$ of $\frac{3}{5}$ of a £. *Ans.* $\frac{4260}{36}$. For $\frac{1}{2}$ of $\frac{2}{3}=\frac{2}{6}$, and $\frac{2}{3}$ of $\frac{3}{5}=\frac{6}{15}$; therefore, divide £47 $\frac{2}{6}$ by $\frac{6}{15}$, that is, divide $\frac{284}{6}$ by $\frac{6}{15}$. First, $284\times15=4260$ *NN.* and $6\times6=36$ *ND.* *Ans.* $\frac{4260}{36}$, or £118 $\frac{12}{36}$=6*s.* 8*d.*

Tyro. Then I perceive that *Division* of Fractions makes more of a Sum after divided than before.

Philo. Yes certainly, when the *Divisor* is a *Simple* Fraction, or less than Unity, as in this Case; and it answers the same End as common *Multiplication*, *viz.* increases the Value.

Tyro.

Tyro. Explain this a little more, pray?

Philo. Obſerve then the following Example.

3. It is required to bring 42 Guineas into Farthings by *Diviſion* only?

Here by *Caſe* 4, I reduce a Farthing to the Fraction of a Guinea, and find it $\frac{1}{1008}$ for a *Diviſor*. Then I make 42 Guineas a *Dividend*, thus, $\frac{42}{1}$. Now, $\frac{42}{1} \div \frac{1}{1008} = 42336$ Farthings.

☞ From hence, *Tyro*, ariſes this Obſervation, That where any *Whole Number* is divided by a *Simple* Fraction, the Quotient will be ſo much *larger* than the Dividend, as the Diviſor is *leſs* than the Unity, or 1; but on the contrary, when a *Simple* Fraction is to be divided by a *Whole Number*, then the Quotient will be ſo many Times *leſs* than the Dividend, as the Diviſor exceeds Unity.

Thus £4 divided by $\frac{1}{4}$ of a £. is the ſame as to multiply it by £4, *viz.* £16: But $\frac{1}{4}$ divided by 4 is $= \frac{1}{16}$ only, *viz.* but 1 *s.* 3 *d**.

And now *Tyro*, we are come to that Rule wherein all the others are exerciſed, *viz.*

SECTION VII.

The Rule of Three *in* Vulgar Fractions.

Tyro. HOW is this Rule performed?

Philo. After having reduced *Compound Fractions* and *Mixt Numbers*, as before directed, Firſt, (as in the common *Rule of Three*) make your *firſt* and *third*

* See more of the Nature of *Vulgar Fractions* in my *Young Algebraiſt's Companion*, Dialogue 3, Caſe 3, 4.

Number of one Name; then multiply your *second* by your *third*, and divide by your *first*.

Or rather thus:

Having stated the Question, and reduced the Fractions, multiply the Denominator of the *first* Number into the Numerators of the *second* and *third* Numbers, for a new Numerator, and the Numerator of the *first* Number into the Denominator of the *second* and *third*, for a new Denominator, and that is your Answer required.

1. If $\frac{3}{4}$ of a Yard cost $\frac{5}{6}$ of a £. what cost $51\frac{1}{4}$ Yards.

$$\begin{array}{r} 4 \\ \hline 205 \\ \hline 4 \end{array}$$

Thus, $\frac{3}{4}$ $\frac{5}{6}$ $\frac{205}{4}$. Now I begin with the Denominator of the *first* Fraction, thus, $4\times5\times205=4100$ *N. N.* And $3\times6\times4=72$ *N. D.* So is the Answer $\frac{4100}{72}$ of a £=£56 18*s.* 10*d.* $\frac{1}{2}$ $\frac{48}{72}$ $\frac{2}{3}$.

2. If a Load of Wheat cost £15 $\frac{2}{12}$, what cost one Bushel?

Here, as 40 Bushels make 1 Load, my *first* Number will be $\frac{40}{1}$ the *second* Number reduced to an *Improper* Fraction is $\frac{182}{12}$, and 1 Bushel will be $\frac{1}{1}$. Then, if $\frac{40}{1}$ be $\frac{182}{12}$ what $\frac{1}{1}$ Now $1\times182\times1=182$ *N. N.* and $40\times12\times1=480$ *N. D.* *Ans.* $\frac{182}{480}$, which is=7*s.* 7*d.*

Tyro. This is easy enough, if this be a general Rule.

Philo. It is, and if you look over what has been done, you may with Ease do any Thing in this Rule; therefore, I shall only set you a few Questions for Practice.

3. What

3. What is the Intereſt of £219 $\frac{2}{3}$ for one Year, at £5 $\frac{3}{8}$ *per Cent.* *Anſ.* $\frac{28337}{2400}$, *viz.* £11. 16*s.* 1*d.* $\frac{1}{2}$ $\frac{1920}{2400}=\frac{4}{5}$.

4. Bought South-Sea Stock to the Value of £420 13*s.* 4*d.* and gave £95 $\frac{4}{5}$ *per Cent.* what comes it to? *Anſ.* £402 19*s.* 11*d.* $\frac{1}{2}$ $\frac{108}{150}$ $\frac{18}{25}$.

5. A Perſon left 40 Shillings to 4 poor Widows, *A. B, C*, and *D*. To *A* he left $\frac{1}{3}$, to *B* $\frac{1}{4}$, to *C* $\frac{1}{5}$, and to *D* $\frac{1}{6}$, deſiring the Whole might be diſtributed accordingly; I demand the proper Share of each?

Take $\frac{1}{3}$, $\frac{1}{4}$, &c. of 40 Shillings, and add them together, it makes but 38 Shillings: Then ſay,

If 38*s.* be $\frac{1}{3}$, *viz.* 13*s.* 4*d.* what will 40 be? Thus proceed with all their Shares, you will find *A* muſt have 14*s.* $\frac{16}{86}$, *B* 10*s.* 6*d.* $\frac{12}{38}$, *C* 8*s.* 5*d.* $\frac{2}{38}$, and *D* 7*s.* 0*d.* $\frac{3}{38}$.

And now, *Tyro*, we will proceed to

DIALOGUE XIII.

SECTION I.

NOTATION *of* DECIMAL FRACTIONS.

Tyro. WHAT do you mean by a *Decimal*?

Philo. Any Number, whether with Cyphers before it or not, having a Dot before them, thus, .2 .005 or .4715, &c. are *Decimals*.

Tyro. How are theſe *Decimals* formed?

Philo. Every *Decimal* is a *Vulgar Fraction*, having as many Cyphers for its Denominator, and an Unit beſides.

sides. Thus the foregoing *Decimals* expressed in *Vulgar Fractions* are $\frac{2}{10}$, $\frac{005}{1000}$, and $\frac{4715}{10000}$, *&c.* but the Denominators are cast away in *Decimals,* because you see they are always known, and we work only with the Numerator, or the *Decimal* itself; and this is the Reason that *Decimal Fractions* are so very easy to what *Vulgar* are.

Tyro. I understand you; but have you no *Mixt* Numbers here as well as in *Vulgar Fractions?*

Philo. Yes: A *whole* Number, and a *Decimal* after it, is a *Mixt* Number. Thus, 47 .5 or 5 .25 are *Mixt* Numbers, signifying 47 *whole Numbers,* and $\frac{5}{10}$th Parts of $\frac{1}{2}$; and the other is 5 *whole Numbers,* and .25 hundredth Parts, or 1 Quarter, for 25 is $\frac{1}{4}$ of 100.

Note 1. Cyphers after Figures are of no Signification in *Decimals,* thus, .500 is but .5 and .750000 is but .75 for .500 is $\frac{500}{1000}$, which is the same as $\frac{5}{10}$: But Cyphers before *Decimals* are necessary, for they decrease their Value. Thus, 5 is 5 tenth Parts, or $\frac{1}{2}$, but .05 is but the 5 one hundredth Part, *viz.* $\frac{5}{100}$ in *Vulgar Fractions.*

Note 2. Pray remember this: That .5 signifies the *Half* of any *whole* Number, Thing, or Integer. .25 is *one Quarter,* and .75 signifies *three Quarters.* For .5 is $\frac{1}{2}$ of 10, .25 is $\frac{1}{4}$ of 100, and .75 is $\frac{3}{4}$ of 100.

This being well understood, you may proceed to *Addition.*

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SECTION II.

Addition *of* Decimals.

Tyro. HOW is *Addition* of *Decimals* performed?

Philo. The ſame as common *Addition*, only with this Difference, that you muſt ſet Tenths under Tenths, and hundred Parts under hundred Parts, not regarding the Number of *Decimal* Places, but ſet them all even towards the firſt Left-hand Row, that ſtands next the *whole* Numbers, and then add them all together as in *Whole Numbers*.

One Example well explained will be ſufficient, for you will ſee the Reaſon more plainly in *Reduction*.

1. Add £47 .45 .7259 £5 .25 .000545 and 15.5 together.

47.45 .7259 5.25 .000545 15.5 ————	Here you ſee I place the *Whole Numbers* under one another, as in *Addition*, and the *Decimals* I place even next the *Whole Numbers*, not regarding how far they extend to the Right-hand: Then I add them as they ſtand,
Anſ. 68.926445	like *Whole Numbers*.

2. And .575 .005 .0005 .95 and .3 together.

Anſ. 2.5055. If you ſet theſe under one another, and add them as before, you will have 2 *whole* Numbers, and .5055.

Note, Always remember to part the *Decimals* from the *whole* Numbers by a Dot. Thus, I find in caſting up this laſt Sum it amounts to 5 Figures; but as there are but 4 Figures in the largeſt *Decimal*, therefore, I make a Dot between the 4th and 5th Figure, always keeping an equal Number of *Decimal* Places.

SECTION III.

SUBTRACTION *of* DECIMALS.

Tyro. IF *Addition of Decimals* be performed like *Whole Numbers*, I imagine *Subtraction* is the ſame.

Philo. It is ſo, only place the Figures to the Left-hand, always under one another, let them be Cyphers or Figures; but don't regard Cyphers to the Right. An Example will make it quite eaſy.

From	47.0075	From	.7	From	5 25
Take	15.51	Take	.275	Take	.98407
Anſ.	31.4975	*Anſ.*	.425	*Anſ.*	4.26593
Proof	47.0075	Proof	.7	Proof	5.25

Here you ſee I do by *Tens*, as in *Whole Numbers*, and borrow and carry the ſame, only I never ſet down Cyphers to the Right-hand of the Figures, but entirely diſcard them.

2. Borrowed 100 Guineas, and paid at three ſeveral Times, each £27.275 what is to pay? *Anſ.* £23.175 or £23. 3*s.* 6*d.*

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SECTION IV.

MULTIPLICATION *of* DECIMALS.

Tyro. HOW is *Multiplication* performed?

Philo. Like common *Multiplication*, having no Regard at all to the *Decimals* till the Work is done, and added up: Then count how many *Decimal* Places you have both in the *Multiplicand* and *Multiplier*, and as many *Decimals* as you find in both these, so many Figures you are to prick, or point off from the Right-hand to the Left: So will the Figures on the Left-hand of the Dot be *whole* Numbers, and those towards the Left, *Decimal* Parts.

EXAMPLES.

Multiply	7.256	Multiply	.5759
	by .762		by .0375
	14512		28795
	43536		40313
	50792		*17277
Ans.	5.529072	*Ans.*	.02159625

Here in *Example* 1, I have 6 *Decimals* in the *Multiplicand* and *Multiplier*; therefore, I prick, or dot off 6 towards the Left-hand, and have 5 for a *whole* Number, and the rest are *Decimals*.

* *Note*, In *Example* 2, I have 8 *Decimals* in the *Multiplicand* and *Multiplier*; but I find upon casting them up, that there are but 7 Places of *Decimals*, therefore, I place a Cypher before the first Figure, and make a Dot before the Cypher, so I have 8 *Decimal* Places.

This is a standing Rule; for had the Product been less in the Number by 2, 3, or more Places, so many Cyphers must have been added to supply the Deficiency.

Tyro. This is easy enough, as you observed, to what *Vulgar Fractions* are: And I perceive that *Money*, *Weight*, or *Measure*, may be easily multiplied by this Rule.

Philo. You say right: For, suppose I was to multiply £4. 15*s.* by £3. 10*s.* it would produce £16. 12*s.* 6*d.* For £4. 15*s.* is 4.75 (because 15*s.* is $\frac{3}{4}$ of a £) and £3. 10*s.* is £3.5. Therefore, £4.75×3.5=£16.625, or 12*s.* 6*d.*

3. Multiply .000075 by .0015. *Ans.* .0000001125.

4. Multiply $4\frac{1}{2}$, *viz.* 4.5. by 4.5 *Ans.* 20.25, or $20\frac{1}{4}$.

5. Multiply $\frac{1}{2}$ a Crown by $\frac{1}{2}$ a Crown, at a Shilling the Integer. *Ans.* 6-25. *viz.* 6*s*-3*d.*

See *Multiplication of Vulgar Fractions*; and more of the Nature of this, with the Way and Manner of valuing any *Decimal*, in *Reduction of Decimals*.

SECTION IV.

Division *of* Decimals.

Tyro. HOW is *Division* performed?

Philo. The same as common *Division*; but being a little more difficult than the other Rules, you must be the more careful: But if you observe the three following Notes, they will help you to work any Sum.

Note 1. When there are more *Decimal* Places in the *Dividend* than in the *Divisor*, then (after the Work is done) prick off as many in the Quotient to supply that Defect; that is, the *Decimals*, Places of the *Divisor*, and the *Quotient* must always be equal in Number to those in the *Dividend*.

Note

Note 2. If there be more *Decimal* Places in the *Divisor* than in the *Dividend*, (before you begin to work) add as many Cyphers to the *Dividend* as make the Number of *Decimal* Places equal to the *Divisor*, and proceed as before directed.

Note 3. When it happens that the *Decimal* Places in the *Divisor*, and *Quotient* (after the Work is done) are not so many as those of the *Dividend*; then you must place as many Cyphers before the Quotient, or Answer, as will make up that Deficiency.

.5)47.3476	.12)63.00	12.).063
Ans. 94.6952	*Ans.* 525	*Ans.* 00525
See Note 1.	*See Note* 2.	*See Note* 3.

☞ Remember that all Remainders in *Decimals* after *Division* are of no Signification, and therefore are taken no Notice of.

The same is to be observed in long *Division* as in the three foregoing Examples in relation of pointing off.

```
47.15)3.747565(.0794  Ans.
      33005
      -----               But if thus.
       44706
       42435       .4715)3.747565(7.94  Ans.
       -----
        22715
        18860
       -----
```

Here you see the same Sum is proposed, but the Answer is different, as you may prove at large; for the Figures will be the same. And thus you see, let them be *whole* or *mixt* Numbers, the Work is the same.

Tyro. I understand it: And I perceive it is very easy to divide Money into any Number of Parts by this Rule.

N 5 *Philo.*

Philo. Very easy indeed.

6. Divide £42 19*s*. 6*d*. by £4 15*s*. 6*d*. That is, divide £42.975 by £4.775. *Ans.* £9.

7. Divide £4.5 (*viz.* £4 10 *s.*) by £3.5 (*viz.* £3. 10 *s.*) *Ans.* £1.285, or £1 5 *s.* 8 *d.* $\frac{1}{4}$.

8. Divide 1.753 by £1753. *Ans.* 001.

This Example, tho' it appears trifling at first, may be of Service. For suppose it was required to divide £1. 753 among 1753 Persons, the Answer would be .001, *viz.* 1 Farthing each. Thus may you vary or alter *Decimals* at Pleasure, but as for Money, and the Manner of finding its Value in any *Decimal Fraction, that* you will see in the next *Section*, which if you observe well, you will see the whole Order of *Decimals*, and their Relation, and Harmony, compared with *Vulgar Fractions*.

SECTION VI.

REDUCTION *of* DECIMALS.

Tyro. WHAT does *Reduction of Decimals* teach?

Philo. It teaches to reduce a *Vulgar Fraction* to a *Decimal* of the same Value, and also shews you how to find that Value, either in *Money*, *Weight*, or *Measure*, &c.

CASE 1.

To reduce a Vulgar Fraction *to a* Decimal.

Add as many Cyphers as you please to the Numerator, (making a Dot between the Numerator and the Cyphers) then

then divide by the Denominator, as in common *Division*, and making a Dot before the Figures in the Quotient, you have the *Decimal* equal to the *Vulgar Fraction*.

1. Reduce $\frac{3}{4}$ to a *Decimal*. *Ans*. .75.

$$\begin{array}{r} 4)3.00 \\ \hline .75 \end{array}$$

Here you see .75 is $=\frac{3}{4}$, for .75 is $\frac{3}{4}$ of 100, its proper Denominator.

2. Reduce $\frac{5}{8}$ to a *Decimal* of the same Value.

$$\begin{array}{r} 8)5.000 \\ \hline .625 \end{array}$$ *Ans*.

That is, .625 is $\frac{5}{8}$ of 1000, its Denominator.

3. Reduce $\frac{5}{395}$ to a *Decimal*. *Ans*. .01265.

4. Reduce $\frac{3}{1753}$ to a *Decimal*. *Ans*. .00171.

Note, Sometimes in reducing a *Decimal* there will be a Remainder; but never regard that, if you have 5 *Places* in a *Decimal* it is sufficient.

CASE 2.

To reduce the known Parts of Money, Weight, *or* Measure *to a* Decimal.

Add Cyphers to the lowest Denomination (making a Dot between the Cyphers and the Figure) and divide by the Parts contained in the next higher Denomination; then place the next higher Denomination, before that Quotient (with a Dot between) and divide by the Parts contained in the next higher Denomination; and so go on, and your last Quotient will be the *Decimal* required.

But this must be illustrated by an Example to make it plain.

1. What

1. What is the Decimal of 14 *s.* 6 *d.* $\frac{3}{4}$?

4) 3.00000
12) 6.75000
2|0)14.56250
.728125 *Ans.*

Here, according to the Rule, I add Cyphers to the lowest Denomination, 3 Farthings, and divide by 4; then I place the 6 Pence before that Quotient, and divide by 12. *Lastly*, I place 14 Shillings before this last Quotient, and divide by 20, (*viz.* by 2) without cutting any Figure or Cypher off to the Right-hand; for there is no Occasion for that.

See the Proof of this in *Example* 1, next *Case*.

2. What is the *Decimal* of 18 *s.* 9 *d.* $\frac{1}{2}$? *Ans.* .93958

Note 1. If you would know the Decimal of any Number of Shillings, from 1 to 19, observe this general Rule: If the Shillings be even, take the $\frac{1}{2}$ of them is the Decimal. Thus, the Decimal of 16 *s.* is .8, and of 18 *s.* is .9, *&c.* But if the Shillings be odd, multiply them by 5, gives the Decimal. Thus, the Decimal of 5 *s.* is .25; for 5 Shillings is $\frac{1}{4}$ of a £, and 25 is $\frac{1}{4}$ of 100. So also, the Decimal of 17 *s.* is .85, and 11 *s.* is 55, and the Decimal of 1 *s.* is .05; for there must be 2 Places, when the Shillings are odd.

A RULE *to find the* Decimal *of Shillings, Pence, and Farthings, at a £. Sterling, the Integer at once.*

1. For *Shillings.* Add Cyphers to the Shillings, and divide by 20.

2. For the *Pence.* Add Cyphers to the given Pence, and divide by 240, the Pence in a £. pricking off according to the Rule of *Division.* Thus you will find the Decimal of 6 *d.* .025 and of 3 *d.* .0125.

3. For

3. For *Farthings*. Add Cyphers, and divide by 960: Thus the Decimal of 3 Farthings is .003125

Note, The ſame is to be obſerved in finding the Decimal of Weight and Meaſure, by adding Cyphers to the given Denomination, and dividing by the Parts contained in the Integer.

To tell the Decimal *of* Shillings, Pence, *and* Farthings, *by Inſpection*.

Note, If the Shillings be even, take the $\frac{1}{2}$ of them, which will be the firſt Decimal Figure; then bring the Pence and Farthings into Farthings, and if they be leſs than 5 join them to the firſt Decimal Figure, ſo have you a Decimal of 3 Places; but if the Farthings be more than 5, ſet down 1 more than they really are; if they be above 40 ſet down 2 more than they amount to; ſo have you the Decimal nearly.

1. Let it be required to find the Decimal of 14*s*. 6*d*. $\frac{3}{4}$, and 18*s*. 9*d*. $\frac{1}{2}$, as before. Here I ſay the $\frac{1}{2}$ of 14 is .7, the firſt Figure; then 6*d*. $\frac{3}{4}$ is 27 Farthings, but being above 5, I ſet down 28 Farthings by the Side of the 7, ſo is the Decimal .728 as before; and ſo for the other.

2. What is the Decimal 6*s*. 10*d*. $\frac{1}{2}$? *Anſ*. .344
Here the $\frac{1}{2}$ of 6*s*. is 3, and 10*d*. $\frac{1}{2}$ is 42 Farthings; but being above 40, I, by the Rule, ſet down 2 more, *viz*. 44; ſo is the Decimal .344 nearly.

Note, When the Shillings are odd, multiply them by 5, and bring the Pence and Farthings into Farthings, as before, and ſet the firſt Figure under the ſecond Figure of the Decimal belonging to the Shillings, encreaſing them by 1, or 2, as before, you have the Decimal.

3. What

3. What is the Decimal of 17*s*. and 6*d*. $\frac{3}{4}$: And 11*s*. 10*d*. $\frac{3}{4}$?

17 multiplied by 5 is	.85	$11 \times 5 = 55$
$6\frac{3}{4}$ more 1 Farthing	28	10*d*. $\frac{3}{4} + 2 + 45$
Ans.	.878	.595

The next *Case* is a Proof to this, and more useful.

CASE 3.

To find the Value of a Decimal *in* Money, Weight, *and* Measure.

Multiply the Decimal by the Parts contained in the Integer, and prick off as many Figures as there are Places in the given Decimal, and the Figures towards the Left-hand will be Whole Numbers, and those that are pricked off are Decimals, which Decimals only must be multiplied by the next Denomination: Thus go on, multiplying and pricking off the same Number of Decimals; so will the Figures towards the Left-hand be the Value required.

1. What is the .728125 of a £. Sterling?

```
         .728125
              20
       ---------
    s.14 562500
              12
       ---------
       d.6.7500
              4
       ---------
       qrs 300
```

Ans. 14*s*. 6*d*. $\frac{3}{4}$. See *Ex*. 1 of last *Case*.

2. What is the .7615 of a Guinea?

```
          .7615
             21
        -------
           7615
          15230
        -------
      s.15.9915
             12
        -------
      d.11.8980
              4
        -------
      qrs.3 5920
```

Ans. 15*s*. 11*d*. $\frac{3}{4}$

3. What

3. What is the .1756 of a Ton?

```
      20
  ------
C 3.7120
       4
  ------
qrs 2.0480
      28
  ------
    3840
   0960
  ------
lb. 1.3440
      16
  ------
oz. 5.5040
```

Anſ. 3 *C.* 2 *qrs.* 1 *lb.* 5 *oz.*

4. What is the .09715 of a Bar.

```
         36
     ------
      58290
     29145
     ------
Gall. 3.49740
            8
     ------
Pints 3.97920
```

Anſ. 3 *Gall.* 3 *Pints*, and $\frac{9}{10}$, or very near $3\frac{1}{2}$ *Gall.*

To tell the Value of any Decimal *in* Shillings, Pence, *and* Farthings, (*by Inſpection only*) *at a £. Sterling the Integer.*

Note, If there be ever ſo many Places in the *Decimal*, the firſt 3 Figures are ſufficient, and all that are required in Buſineſs.

Note 2. Double the firſt Decimal Place towards the Left-hand, and if the ſecond Figure be under 5, then the firſt Figure doubled will be the *Shillings*; but if the ſecond Figure be 5, or above 5, then you muſt add 1 Shilling more to thoſe you doubled; and what remains over the 5 carry to the next Figure, placing it before it in your Mind, and thoſe will be the Farthings, which, if under 5, ſet down what they amount to; if above 5, not exceeding 40, then abate or ſet down 1 Farthing leſs than they are; and if above 40, ſet down 2 leſs

2 less than they really are, and you have the Value required.

1. What is the Value of .728125 of a £. *Ans.* 14*s.* 6*d.* $\frac{3}{4}$.

Here I double the first Figure 7, which is 14 for the Shillings, and then I say, 28 Farthings is 7*d.* but I abate 1, because it is above 5; so it is 14*s.* and 6*d.* $\frac{3}{4}$.

2. What is the .39525 of a £. *Ans.* 7*s.* 10*d.* $\frac{3}{4}$.

Here I say, twice 3 is 6, and the next Figure being above 5, I count 1 more, which is 7 Shillings; then there is 4 remains from the 9, which I carry to the 5, which is 45 Farthings; but being above 40, I abate 2, and call it 43 Farthings, which is 10*d.* $\frac{3}{4}$.

3. What is the .0672 of a £. Sterling? *Ans.* 1*s* 4*d.*

Here the Cypher doubled is 0; but the second Figure being 6, that is 1 Shilling and 1 over, which I carry to the 7, is 17 Farthings, and abating 1 Farthing is 16, or 4 Pence; which you may prove by multiplying the Decimal by 20, 12, and 4, pricking off, as before directed.

EXAMPLES *for Exercise.*

4. What is the .8145 of a Ton? *Ans.* 16 *C.* 1 *qr.* 4 *lb.* 7 *oz.* 10 *dwt.* .88.

5. What is the .275 of a *lb. Troy?* *Ans.* 3 *oz.* 6 *dwts.*

6. What is the .0729 of a Year, at 365 Days the Integer? *Ans.* 26 Days, 12 Hours, 12 Minutes, 14 Seconds.

These Examples are sufficient for any diligent Learner, therefore, I will proceed to put them all in Practice.

SEC-

SECTION VII.

The Rule of Three Direct *in* DECIMAL FRACTIONS.

Tyro. HOW is the *Rule of Three* in *Decimals* performed?

Philo. The ſame as in the common *Rule of Three Direct*, by multiplying the *ſecond* Number by the *third*, and dividing by the *firſt*.

1. If $\frac{3}{4}$ of a Yard coſt $\frac{5}{6}$ of a £. what coſt $51\frac{1}{4}$ Yards? That is, If 3 *qrs.* coſt 16*s.* 8*d.* what coſt 51 Yards, 1 *qr.*

Decimally thus,

If .75 be 8.333, what is 51 .25 Yards?

Here multiply your *ſecond* by the *third*, and divide by the *firſt*, you have the Quotient 56.942, *viz.* £56 18*s.* 10*d.*

See *Example* 1, *Rule of Three of Vulgar Fractions.*

2. If a Buſhel of Wheat coſt 3*s.* 9*d.* $\frac{1}{2}$, what coſt 40 Buſhels, or 1 Load? *Anſ.* £7 11 *s.* 8*d.*

Decimally thus,

If a Buſhel of Wheat coſt .18958, what coſt 40?

$$\begin{array}{r} 40 \\ \hline £7.58320 \end{array}$$

Anſ. £7 11*s.* 8*d.*

Tyro. This laſt Example is very ſhort indeed.

Philo. It will always be ſo when the *firſt* Number is 1, or Unity; for *Decimals* are ſuperior to *Vulgar Fractions*, for Eaſe and Expedition; and though not always ſo near the Truth itſelf, yet anſwers every Thing near enough for any Buſineſs or Demand. See the next Queſtion in *Variations.*

3. If

3. If $5\frac{1}{4}$ Ells cost £2 $\frac{803}{960}$ of a £. what cost 282 $\frac{1}{2}$ Ells? That is, If $5\frac{1}{4}$ cost £2 16*s.* 8*d.* $\frac{3}{4}$, what cost $282\frac{1}{2}$ Ells?

Decimally thus,

If 5.25 Ells cost £2.8364, what cost 282.5 Ells? *Ans.* £152625 *viz.* £152 12*s.* 6*d.*

4. If 1 Ton of Sweet Oil cost £24.17.4 $\frac{1}{2}$, what cost 14 *T.* 17 *C.* 2 *qr.* 19 *lb.* *Ans.* £370.1335, or 2*s.* 8*d.* $\frac{1}{2}$.

Now, *Tyro*, in all such Sums as these, which either by the *Rule of Three*, *Practice*, or *Vulgar Fractions*, will become very tedious; yet, by finding the Decimal of the odd Weight, and the odd Price, you have only a common *Multiplication* Sum.

That is, multiply 14 Ton .88348 by £24.86875, you will have £370.1335, *viz.* 2*s.* 8*d.* *Ans.*

Note, You may find the Decimal of 17 *C.* 2 *qrs* 19 *lb.* by bringing them into *lbs.* and dividing by the *lbs.* in a Ton, *viz.* 2240 The same for any other *Weight*, or *Measure*, by reducing the Parts, and dividing by the Parts contained in the Integer.

DIA-

DIALOGUE XIV.

SECTION I.

SIMPLE INTEREST.

Tyro. HOW is *Simple Interest* in *Decimals* perform'd?

Philo. Very easily, by the following Rule.

Multiply the Principal by the Rate *per Cent.* and prick off the Decimals, gives the Interest for one Year; and if there be odd Time, take the Parts of the Principal itself, and add to the Work, it is done.

Note, For £4 *per Cent.* multiply by .04; for 5 *per Cent.* by .05; for 6 *per Cent.* .06; for 7 *per Cent.* .07

1. What is the Interest of £147, 15 *s.* for a Year, at £4 *per Cent. per Annum?* *Ans.* 147.75.

What is the Interest of 275.10 for 1 Year, at £6 *per Cent.*

£147.75	£275.5
.04	.06
£5).9100	£16.530
20	
*s.*18) 20	*Ans.* £16. 10*s.* 7*d.* $\frac{1}{4}$.
12	
*d.*2) 40	
4	
*q.*1|60	

And

And the Work will be as eaſy, if the *per Cent.* be for odd Time, as appears by the following Examples.

3. What is the Intereſt of £1250. 15*s.* for $3\frac{1}{2}$ Years, at 6 *per Cent. per Annum?*

	£1250.75
	.06
$\frac{1}{2}$	75.0450 for 1 Year
	3
	225.1250 for 3 Years.
	37.5225 add
	262.6575 for $3\frac{1}{2}$ Years. *Anſ.*

4. A Perſon left his Wife by Will $\frac{1}{3}$ of his Eſtate, which was £355. 7*s.* 6*d.* Now this lay in Hand $3\frac{1}{2}$ Years; I demand what Intereſt is due upon it, at £$4\frac{1}{2}$ *per Cent. per Annum?*
Anſ. £55. 19*s.* 5*d.*

Multiply £355.375 by £$4\frac{1}{2}$, that is, by .045 is £15 .991875 for 1 Year: This multiplied by 3.5 Years gives £55.9715625.

And thus you ſee, that if the *Principal, Intereſt,* or *Time,* be ever ſo much, yet it is eaſily performed by *Decimals.*

5. A Merchant made an Aſſurance upon Goods in a Ship bound to a certain Port, to the Value of £2530, upon Condition, that in Caſe of a total Loſs, or Damage, the *Aſſurers* were to pay £$97\frac{1}{2}$ *per Cent.* deducting $\frac{1}{2}$ *per Cent.* (*viz.* 10*s. per Cent.*) out of it: Now the Ship was caſt away, but there was as many Goods ſaved as amounted to £955; I demand what the Merchant has to receive? *Anſ.* £1527. 18*s.* 11*d.*

First,

First, £955 taken from £2530, remains £1575 Loſs. This multiplied by 97.5 is 1535.625: And deducting $\frac{1}{2}$ *per Cent.* from this, is only cutting off 2 Figures in the Pounds, thus, 15|35, and take the $\frac{1}{2}$ of 15|35.625, which is 7.678125 (placing it in the Units Place of the Pounds, and the reſt in Order, as follows, in *Diviſion*) and ſubtract it from £1535.625, leaves £1527.946875, *viz.* 18*s.* 11*d.* *Anſ.*

The Proof of this is worthy your Obſervation, *Tyro.*

For obſerve 97 $\frac{1}{2}$ *per Cent.* wants but $2\frac{1}{2}$ *per Cent.* of £100, that is, of being *Cent. per Cent.* Now if you multiply £1575 by 2.5 *viz.* ($2\frac{1}{2}$) it gives £39.375, which added to £1535.625, gives the original Sum, or Loſs, *viz.* £1575.

Tyro. I thank you kindly, Sir; for this, as you have obſerved, is a Proof to me very plainly.

6. What comes an Aſſurance, or a Commiſſion Factorage, or Brokerage to, upon £3500, at 18*s.* *per Cent.*

35|00
.9 The Decimal of 18*s.*

£31.5 *Anſ.* £31.10

And thus *Decimals* perform any Thing with Eaſe and Pleaſure.

Tyro. I ſee it, Sir; and now be pleaſed to give me an Example or two in *Compound Intereſt.*

Philo. I will.

SEC-

SECTION II.

COMPOUND INTEREST.

Tyro. HOW is *Compound Interest* performed?

Philo. By continual *Multiplication* and *Addition.*

Quest. 1. What will £100 amount to, if it be forborn 5 Years, at £5 *per Cent. per Annum Compound Interest?* *Ans.* £127 – 12*s.* – 6*d.*$\frac{3}{4}$.

1. The common Method is to multiply the Principal by the *per Cent.* and cut off two Figures (which is the same as dividing by 100) this gives the Interest for one Year, which is £5; this added to £100, gives £105 for the Amount of the first Year. Then this multiplied by the *per Cent.* gives the Interest for the 2d Year, which added to the Principal £105, gives £110-25 for the Amount the 2d Year, &c. &c. But this is tedious; therefore the best Way is,

2. Set down the Principal £100, and find the Interest the 1st Year, and add it to it, and it makes as before 105. Set the 5 under the £100, and make two Dots after it, thus, 5 . . this saves dividing by 100, and will supply the Decimal Places; then multiply £105 by 5 (*viz.* 05 in Decimals) keeping always 2 Figures of the Decimals under the 2 Dots, and it produces 5–25, which added to £105, gives £110.25, as before, &c. &c. See the Operation.

£.100

£100 × *viz.* by .05 is 5.00, *viz.* 5
5 . . added

Amount		
1 Year		105 . . This × .05
	is	5.25 add
2 Year		110.25 This × .05
	is	5.5125 add
3 Year		115.7625 This × .05
	is	5.7881 add
4 Year		121.5506 This × .05
	is	6.0775
5 Year		127.6281 *Anſ.* £127.12

Queſt. 2. *A* lent *B* £136.775. which *B* promiſed to pay *Compound Intereſt* for, at £6 *per Cent. per Annum*, and bound his Heirs, Executors, &c. to that Condition: Now *A* died, and *B* took no Notice of Payment till it was at laſt diſcovered by the Executors of *A*, that *B* had had the Money in Hand 20 Years: I demand what *B* has got to remit for the Debt? *Anſ.* £438.651

But the ſhorteſt Method of all to calculate *Compound Intereſt* is by the following Tables.

TABLE

TABLE I.

A Table, *shewing how much* 1 *Pound* Sterling *will amount to any Number of Years under* 21, *at* £5 per Cent. per Annum Compound Interest.

Years	£5 *per Cent.*	*Years*	£5 *per Cent.*
1	1.05	11	1.7103
2	1.1025	12	1.7958
3	1.15763	13	1.8856
4	1.2155	14	1.9799
5	1.27628	15	2.079
6	1.3401	16	2.1828
7	1.4071	17	2.292
8	1.4744	18	2.4066
9	1.5513	19	2.5269
10	1.6289	20	2.6533

TABLE II.

A Table *shewing how much* 1 *Pound* Sterling *will amount to any Number of Years under* 21, *at the Rate of* £6 per Cent. per Annum, Compound Interest.

Years	£6 *per Cent*	*Years*	£6 *per Cent.*
1	1.06	11	1.8982
2	1 1236	12	2.0121
3	1.191	13	2.1329
4	1.2624	14	2.261
5	1.3382	15	2.3965
6	1 4185	16	2.5403
7	1.5036	17	2.6927
8	1 5938	18	2.8543
9	1.6894	19	3.0256
10	1.7908	20	3.2071

The

1. *The Explanation of the Tables.*

The Amount of £1 for 1 Year, at £5 *per Cent.* is 1.05. This×105=1.1025 the Amount for the 2d Year; this×1.05 is 1.1576, *&c. &c.* The same for £6 *per Cent.* which is 1.06 this into 1.06 is equal 1.1236 for the 2d Year, *&c. &c.*

2. *The Use of the Tables.*

When any Sum is given for any Number of Years, then multiply the given Sum by the Number given right against or answering to the Number of Years, and you have the Answer at one Operation.

Let us take *Example* 1, *viz.* £100, for 5 Years, at £5 *per Cent.*

I look in the Table of 5 *per Cent.* and against 5 Years I find 1.2762, (the Amount of £1 for 5 Years) this multiplied by £100 gives 127.628, *viz.* £127 12s. 6¾ as before.

Tyro. This is short indeed!

Phi. 'Tis the same if it were for 20 Years. Thus in Example 2, *It is required to tell the Amount of* £136-15*s.* 6*d. for* 20 *Years, at* £6 per Cent. Compound Interest.

I look in the Table for £6 *per Cent.* and against 20 Years I find 3.2071 the Amount of £1 for that Time; this multiplied by the Sum £136-15-6. (*viz.* 136.775) gives £438.651, *viz,* £438 13 Shillings and 1 Farthing.

Tyro. I like this very well; but suppose the Years are more than in the Tables, how then?

Philo. Very easy; only add any two or more Numbers together, as make the Number, and multiply the Sums belonging to each Number of Years in the Table together, gives the right Sum for that Number of Years.

Thus, Suppose I wanted to tell the Amount of the last Question for 30 Years, at £6 *per Cent.* Here I take any two Numbers, which added, make 30. Suppose for Example 10 and 20: Against 10 I find 1.7908, and against 20 I find 3.2071, these multiplied together give 5.7432 the Amount of £1 for 30 Years, at £6 *per Cent.* which multiplied into £136.775, gives 785.526 the Amount of this Sum for 30 Years; and thus for any other Number of Years.

Tyro. I heartily thank you, Sir.

Phi. You see how easy it is, and this is the only Method to calculate *Annuities*, *Pensions*, *&c.* except you can do it by *Algebraic* Calculation.

Note, These Tables are easily made, the Construction depends, as I told you in *Simple Interest*, upon this: That let the *per Cent.* be what it will, suppose £4 *per Cent.* say, If 100 be £104, what will £1 be? *Ans.* £1.04 for 1 Year. So also for $4\frac{1}{2}$ *per Cent.* it is £1.045; for 5, it is 1.05, *&c.*

Tyro. I understand you very well, Sir, and shall endeavour, as Time offers itself conveniently, to look over these Things, and make myself yet more perfect.

Philo. You will perform your Promise, I hope; but before I leave you, I will give you a Notion of the Extraction of the *Square* and *Cube Roots*, being very necessary in many Businesses, but especially in the Art of Mensuration, and several other Branches of the Mathematics.

DIALOGUE XV.

SECTION I.

The Extraction of the SQUARE ROOT.

Tyro. WHAT do you mean by the Words *Square* and *Root?*

Philo. A *Square* Number is a Number multiplied by itſelf, *viz.* any Figure or Figures multiplied by the ſame Figure or Figures, the Product is the Square of that Number: Thus, $2\times2=4$, the Square of 2; and $9\times9=81$, the Square of 9.

Tyro. This is plain enough. And what is the *Root* then?

Philo. The *Root* is that from which the *Square* is formed: Thus, I told you before, the Square of 2 is 4, and the Square of 9 is 81; therefore, *vice verſa*, 2 is the *Root* of 4, and 9 is the *Root* of 81, as appears by the following *Table*, which ſhould be readily known.

TABLE.

Roots	1	2	3	4	5	6	7	8	9	10	11	12
Squares	1	4	9	16	25	36	49	64	81	100	121	144

Tyro. How is the *Square Root* extracted?

Philo. I will ſhew you the whole Proceſs, which pray obſerve.

Suppoſe it were required to extract the *Square Root* of 3136, or any other Figures.

First, I set down the Figures thus, 3136, and beginning at the Units Place, I make a Dot or Point over it, and also over every other Figure towards the Left hand, as you see in the Margin; and pray observe, that as many Dots as you have, so many Figures the Root will always consist of, which here are 2.

Secondly, I seek (by the *Table*) the nearest Root to the Figures contained in the first Point of Figures, *viz.* in 31, and find it to be .5, which I place in the Quotient thus, 3136(5, which Figure 5 is called the *Root*, or Part of the Root.

Thirdly, Square the Root, that is, multiply it by itself, and place it under the said first Point, as in common *Division*, and subtract it therefrom, and bring down the next Point, *viz.* 36, and place it by the Side of the Remainder, it is 636, which is called the *Resolvend*, as in the Margin.

```
3136(5
25
----
 636 Resolvend
```

Fourthly, Then I double the Quotient Figure, or Root 5, which is 10, and making another crooked Line, I place it for a *Divisor* right against the *Resolvend*, thus,

```
           3136(5
           25
           ----
Divisor 10) 636 Resolvend
```

Fifthly, I now ask, (as in *Division*) how many Times 10 I can have in the *Resolvend* (always rejecting the last Figure) that is, how many Times 10 are contained in 63, and find it 6 Times, which 6 I put in the Root by the Side of the 5, and also by the Side of the *Divisor* 10, whhich makes 106; then I multiply 106 by 6, which is 636, and nothing remains: Thus I find the Square Root of 3136 to be 56.

```
    3136(56 Root. Ans.
    25
    ----
106)636
    636
```

PROOF.

PROOF.

I ſquare the Root 56, that is, I multiply it by itſelf, *viz.* 56, by 56, and it gives 3136.

2. What is the Square Root of 56169?

```
56169(237 Root Anſ.
4
———
43)161 Reſolvend
   129
———
467) 3269 New Reſolvend
     3269
———
        9
```

Here I proceed the ſame as in *Example* 1, by making a Dot over every other Figure, and find the nearest Root of the firſt Point 5 to be 2, which I ſquare, and place under 5, and remains 1, to which I bring down the next two Figures 61, and it is 161; then I double the Root 2, it is 4, which I place on the Left-hand for a Diviſor. Then I aſk how many Times 4 are contained in 16, which, tho' it be 4, yet upon Trial will be but 3 Times (for you muſt obſerve, it will often be leſs than it looks to be) which 3 I place in the Quotient, and alſo by the Side of the Diviſor 4, which makes it 43; then I multiply 43 by 3, and it is 129; and ſubtracting 129 from 161, I have 32 remains, to which I bring down the next Point, or two Figures 69, and it is 3269, which I call a *New Reſolvend*; then I double the Root 23, which is 46, for a *New Diviſor*, and aſk how many Times 46 I can have in 326, and find it 7, which I place in the Quotient, and alſo after 46, and it is 467; which multiplied by 7, gives 3269. Thus I find the *Square Root* of 56169 to be 237. And for a *Proof* I find 237 multiplied by 237=56169. Do you underſtand it, *Tyro?*

Tyro Very well, Sir: Then I perceive that after I have done with the firſt Figure in the Root, I am to double it, and take down the next Point, and then

double the two Figures, and take down the next Point, and ſo keep on in the ſame Order: Am I not ?

Philo. Your Notion is right, and if you conſider well the Manner of the working the laſt Example, if you have ever ſo many Figures you may do it with Eaſe.

Tyro. But ſuppoſe after the Work there ſhould be a Remainder ?

Philo. That matters not at all; only when you come to prove the Work, after multiplying the Root by itſelf, you muſt add the Remainder to the Product, and it will be equal to the given Number, if the Work be right.

Sums for Practice.

3. I demand the *Square Root* of 2996361. *Anſ.* 1731.
4. I demand the *Square Root* of 3076516 *Anſ.* 1754.
5. What is the *Square Root* of 43623. *Anſ.* 208, and 359 remains over.

N. B. If you have a Mind at any Time to know what the Remainder will produce, add an even Number of Cyphers to the Sum, and double the Root, and proceed as before: Thus, the Square Root of 43623.000000 is 208.861.

2. To extract the *Square Root* of a *Vulgar Fraction.* Extract the *Square Root* of the Numerator for a new Numerator, and of the Denominator for a new Denominator.

6. What is the Square Root of $\frac{25}{81}$? *Anſ.* $\frac{5}{9}$.

Note, When you can't extract the Root of the Numerator and Denominator, then reduce the *Vulgar Fraction* to a *Decimal*, and extract the *Square Root*, you have the Anſwer.

7. What

7. What is the Square Root of 1 and $\frac{3}{5}$?
First, $\frac{3}{5}$ is=6, which is 1.6; then I add Cyphers, thus, 1.60000, and find the Root to be 1.264.

Note, There must be always an equal Number of Decimals.

8. What is the Square Root of 19.2 *Ans.* 4.3817

9. What is the Square Root of .0003 *Ans.* .01732

SECTION II.

The Use of the Square Root *applied to various Branches of the Mathematics.*

10. I Demand what is the mean proportional Number between 30 and 50. *Ans.* 38, 7 Tenths.

Multiply one Number by the other, and add Cyphers, and extract the Square Root, you have 38.7

11. There is a Triangle, whose Base is 30 Inches, and the Perpendicular 40; I demand the Hypothenuse? *Ans.* 50.

Note, The *Perpendicular* is that Part which is right up; the *Base* is that which lies next you, and the *Hypothenuse* is the slanting Side, called also the Diagonal Line.

A General RULE *to find the third Side of any Triangle, having two Sides given.*

1 Having the *Perpendicular* 40, and *Base* 30, as above, to find the *Hypothenuse*, add the Square of the *Base* and *Perpendicular* together, and extract the Square Root of

them, you have the *Hypothenuse*. Thus the Square of 30=900. The Square of 40=1600, their Sum is 2500, the Square Root of which is 50, the *Hypothenuse* required.

2. Having the *Hypothenuse* and *Perpendicular*, or *Base* given, to find the other Side.

From the Square of the *Hypothenuse* take the Square of the *Base*, or *Perpendicular*, and the Square Root is the other Side required.

EXAMPLE.

12. There is a Steeple to whose Vane or Top a String is tied, which reaching to the Ground, is in Length 60 Yards, and the Distance from where it touches the Ground to the Middle of the Steeple End is 25 Yards; I demand the Height of the Steeple? *Ans.* 54.5 Yards.

Square 60 is 3600, and take the Square of 25, *viz.* 625 from it, and extract the Square Root, you have 54.5

13. Suppose a Ship sails from a certain Port, has made 87 Miles Difference of Latitude, and 71 Miles Departure, what is her Distance on a regular Course? This is only finding the *Hypothenuse*; for add the Square of 87 and 71 together, and extract the Square Root, you have 112.2 Miles Distance.

14. There is a Circle or Triangle, whose superficial Content is 30800.25, I demand the Side of a Square, whose superficial Content shall be equal thereto? *Ans.* 175.5

15. Suppose a Rope 15 Inches round, I demand the Compass of another Rope, that is double the Strength? Square the Compass of the Rope, it is 25, which multiply by 2, and extract the Square Root, it is 7.07 Inches. If it were required to be 3, 4, 5, or 6 Times the Strength, then multiply the Square by 2, 3, 4, 5, or 6, and extract the Root.

16. There

16. There is a Cable 10 Inches round, which weighs 21 *C.* I demand the Weight of one 8 Inches round? *Anſ.* 13.44 *C.*

As the Square of the one, *viz.* 100, is to the Square of the other, *viz.* 64, ſo is the Weight of the one to the other, *viz.* 13.44 *C.*

17. There is a Circle whoſe Content is 153.9385, I demand its Diameter?

Firſt, as 22 is to 28 : : 153.9385 to the Square of the Diameter, *viz.* 195.9217 whoſe Square Root is 13.99

And thus I think I have given you ſufficient Examples in this Rule, that you may with a little more Practice become quite Maſter of it.

Tyro. I thank you for your Care, Sir, and I underſtand it very well; I wiſh I underſtood the *Cube Root* as well.

Philo. That you may ſoon do by Care, and a little more Pains, tho' it be ſomething more difficult than this Rule.

DIALOGUE XVI.

SECTION I.

The Extraction of the CUBE ROOT.

Tyro. WHAT do you mean by a *Cube?*

Philo. A *Cube* is *that* which has *Length, Breadth,* and *Thickneſs.* Thus, ſuppoſe a Piece of Wood to be cut into the Form of a Dye (or *Dice*) which is equal every Way in *Length, Breadth,* and *Thickneſs,* ſuch a Figure is called a Solid, and by Name a *Cube.*

Tyro. Give me a further Description of a *Cube* in Figures.

Philo. You know any Number multiplied by itself is a Square; so any Number multiplied twice into itself is a *Cube* Number: Thus, the *Cube* of 2 is 8: For 2×2 is 4, and 4×2=8: So also, the *Cube* of 5 is 125: For 5×5×5=125. Thus you see 8 is the *Cube*, and the *Root* of that *Cube*. Also, 125 is a *Cube* Number, whose *Root* is 5, as appears by the following *Table* of both *Squares* and *Cubes*.

TABLE.

Roots	1.	2.	3.	4.	5	6.	7	8.	9.
Squares	1.	4.	9.	16.	25	36.	49	64.	81.
Cubes	1.	8	27.	64.	125.	216.	343.	512.	729.

Tyro. How is the *Cube Root* extracted?

Philo. To give you a Rule for it (I look upon) would be too tiresome for your Memory, as there are many Parts contained in it: I shall therefore take an Example or two, and proceed in the whole Process, or Order of the Work.

1. I demand the *Cube Root* of 32768? *Ans.* 32.

RULE 1.

First, I make a Dot over every *fourth* Figure, begining at the Units Place, as in the Margin, and as many Dots as you have so many Places the *Root* will contain, which here are two Places, 32768

Secondly, Seek the *Root*, (or nearest *Root*) to the first Point 32, which (by the *Table*) is 3, and place it in the Quotient, which is the first Figure in the *Root*, thus, 32768(3.

Thirdly,

Thirdly, Cube the Figure which you put in the Quotient (that is, $3 \times 3 \times 3 = 27$) and place it under the first Point 32, and ſubtract it therefrom, thus

$$\begin{array}{r} \dot{3}2\dot{7}68(3 \\ 27 \\ \hline 5 \end{array}$$

Fourthly, To this Remainder (5) bring down all the Figures of the next Point (*viz.* 768) an place them by the Side of the Remainder, and call this the *Reſolvend*, Thus,

$$\begin{array}{rl} 32768(3 & \\ 27 & \\ \hline 5768 & \textit{Reſolvend} \end{array}$$

Fifthly, Triple the Quotient (that is, always multiply it) by 3 (be it what it will) and place the Units Place of it under the Tens Place of the *Reſolvend*, and call that the *Triple Quotient*, Thus,

$$\begin{array}{rl} \dot{3}2\dot{7}68(3 & \\ 27 & \\ \hline 5768 & \textit{Reſolvend} \\ \hline 9 & \textit{Triple Quotient} \end{array}$$

Sixthly, Now ſquare the Quotient (that is 9) and triple that Square, that is 27, and place the Units Place of it under the Tens Place of the *Triple Quotient*; that is, place it one Figure more to the Left-hand, and call it the *Triple Square*, thus

Seventhly, Add theſe two together, and call it the *Diviſor*, Thus,

$$\begin{array}{rl} \dot{3}2\dot{7}68(3 & \\ 27 & \\ \hline 5768 & \textit{Reſolvend} \\ \hline 9 & \textit{Triple Quotient} \\ 27 & \textit{Triple Square} \\ \hline 279 & \textit{Diviſor.} \end{array}$$

Eighthly,

Eighthly, Ask how many Times the *Divisor* is contained in the *Resolvend*, rejecting the last Figure as you did in the *Square Root*; that is, ask how many Times 279 you can have in 576, the *Resolvend*, which here is 2, and place *this* also in the Quotient, which now is 32.

```
      32768(32
      27
      ----
       5768 Resolvend
      ----
          9 Triple Quotient
      27    Triple Square
      ----
Thus, 279   Divisor
```

Ninthly, Cube the Figure last put in the Quotient (*viz.* 2, whose Cube is 8) and place the Units Place under the Units Place of the *Resolvend*.

```
32768(32 Root
27
----
 5768 Resolvend
----
   9  Triple Quotient
27    Triple Square
----
279   Divisor
----
    8 Cube of 2
```

Tenthly, Multiply the Square of the Figure last put in the Quotient (*viz.* 4) into the *T. Quotient viz.* X9. (which is 36) and place the Product one Figure more towards the Left-hand

```
  32768(32 Root
  27
  ----
   5768 Resolvend
  ----
     9  Triple Quotient
  27    Triple Square
  ----
  279   Divisor
  ----
      8 Cube of 2
    36  The Square of 2 by Triple Quotient
```

Eleventhly,

Eleventhly, Multiply the *Triple Square* (*viz.* 27) by the last Figure put in the Quotient, and place also this one Figure more towards the Left-hand, which is 54.

32768	(32 *Root. Ans.*
27	
5768	*Resolvend*
9	*Triple Quotient*
27	*Triple Square*
279	*Divisor*

Twelfthly. Add these 3 last Numbers together as they stand, and call it the *Subtrahend*, which is 5768 equal to the *Resolvend*

8	*Cube of* 2
36	*Square of* 2 *by T. Quotient*
54	*Triple Square by the Root* 2
5768	*Subtrahend*

Thus is the Work finished, and the *Cube Root* of 36768 is found to be 32.

PROOF.

For the Proof of this I multiply 32 by 32, and it is 1024, which 1024 I multiply by 32 again, and have 32768.

Note 1. If the *Subtrahend* had been larger than the *Resolvend*, then I must put a less Figure in the second Place in the Quotient, and proceed as before directed.

Note 2. When there is another Point of Figures to take down, first, subtract the *Subtrahend* from the *Resolvend*, and to the Remainder bring down the next Point, calling it *New Resolvend*, or *Second Resolvend*: Then proceed to work as after the *first Resolvend* in every Respect.

2. Another

2. *Another Method to extract the* Cube Root, *which is in many Respects easier and shorter than the former.*

Let us take the last Example 32768.

First, Find the Root of the first Point, as before, and subtract it therefrom, and to the Remainder bring down the next Point of Figures, and call it *Resolvend*, or *Dividend*, which you please.

Secondly, Square the Root, and multiply it by 300 for a *Divisor*; and, as in common *Division*, see how many Times it is contained in the *Dividend*, and place it in the Quotient, or Root, accordingly

Thirdly, Multiply the *Divisor* by the last Figure of the Root, and place it under the *Dividend* (Units under Units) drawing a Line between them.

Fourthly, Square the last Quotient Figure, and multiply it by the first Quotient Figure, and that Product multiply by 30, and set this under the last Work, Units under Units, *&c.*

Fifthly, Cube the last Figure, and put the Units of this under the Units of the last, and add these three together in Order, as they stand, which is the *Subtrahend*; which, if it be more than the *Resolvend*, or *Dividend*, you must put a less Figure in the Quotient, and proceed as before; but if it be less than the *Dividend*, subtract it therefrom, and the Work is done, for two Figures in the Root: But if there be more Figures, bring them down to the Remainder, and call it a *New Dividend*; and square the whole *Root*, and multiply it by 300, for a *New Divisor*, and put the Figures in the Quotient. Then square this last Figure, and multiply it by the foregoing Figures in the Root, and then by 30. *Lastly*, Cube the last Figure, and place it as before directed, and the Work is done for three Places. The same to be observed for more Figures.

Thus,

Thus, the laſt Example 32768(32 *Root. Anſ.*

27

Diviſor 2700) 5768 *Dividend*

5400

360

8

5768 *Subtrahend.*

Tyro. I underſtand it very well, and I think this laſt Way the eaſieſt.

Philo. Take your Choice, as I obſerved before; I ſhall now only ſet you one Sum at large, the firſt Way, which you may prove by the ſecond.

2. What

2. What is the *Cube Root* of 12812904? *Ans.* 234.

12812904(234	*Root. Ans.*
8	
4812	*Resolvend*
6	*Triple Quotient*
12	*Triple Square*
126	*Divisor*
27	*Cube of* 3
54	*Square of* 3 *by T. Quotient*
36	*Triple Square by the Root* 3
4167	*Subtrahend*
645904	*New Resolvend*
69	*Triple Quotient*
1587	*Triple Square*
15939	*New Divisor*
64	*Cube of* 4
1104	*Square of* 4 *by T. Quotient*
6348	*Triple Square by the Root* 4
645904	*New Subtrahend* = *New Resolvend.*

This you may easily prove the other Way at Leisure. Also 234×234×234=12812904.

QUESTIONS *for Practice.*

3. What is the *Cube Root* of 5396209064? *Ans.* 1754.

4. I de-

4. I demand the Cube Root of 9423479350146861? *Ans.* 211221.

To extract the Cube Root *of any* Vulgar *or* Decimal Fractions.

5. What is the *Cube Root* of $\frac{27}{1331}$? *Ans.* $\frac{3}{11}$.
6. What is the *Cube Root* of $\frac{2197}{9261}$? *Ans.* $\frac{13}{21}$.

Extract the *Cube Root* of the Numerator and Denominator for a new Numerator and Denominator.

7. Extract the *Cube Root* of 32.768 *Ans.* 3.2.
Proceed as in *Whole Numbers*, only prick off as many Decimals in the Root as you have Dots over the Decimals.

Note, As in the *Square Root* you added either 2, 4, 6, *&c.* Cyphers to the Decimal; so here you must add by *Three*'s, that is, you must add either 3, 6, or 9, *&c.* Cyphers.

8. What is the *Cube Root* of .002? *Ans.* .1259, and .4383021 remains.

SECTION II.

The Use of the CUBE ROOT.

9. THERE is a *Cube*, whose Solidity is 1372 Feet, I demand the Side of a *Cube*, whose Solidity is 4 Times less? *Ans.* 7.
Divide 1372 by 4, and extract the *Cube Root*.

10. If a Bullet 2 Inches Diameter weigh 3 *lb.* what will one of the same Metal weigh which is 8 Inches Diameter? *Ans.* 192 *lb.*

Solids

Solids being in triple Proportion to their Sides, or Diameters, it is thus found.

As the *Cube* of the given Diameter is to the Weight, so is the *Cube* of the other Diameter to the Weight of the other required.

12. Suppose a Shot of 4 Inches Diameter weighs 18 *lb.* I demand the Diameter of another, that weighs 144 *lb.* *Ans.* 8 Inches. This is the Reverse of the last Question.

13. There is a Sphere, or Globe, whose solid Content is 250047 Inches: I demand the Side of a *Cube*, whose *Solidity* shall be equal to the *Solidity* of the *Globe*. *Ans.* 63 Inches.

14. A Country Farmer lent his Neighbour out of his Hay Stack 20 Feet of Hay in Length, Breadth and Depth, and his Neighbour brought him Home 10 Feet at one Time, and 10 at another: How is the Balance, and who Debtor? *Ans.* 6000 Feet due to him that lent it; he having received but $\frac{1}{4}$th.

15. Suppose a Ship 300 Tons Burthen, 75 Feet by the Keel, 29 $\frac{1}{2}$ Feet by the Beam, and 14 Feet deep in the Hold; I demand the Dimensions of another Ship of the same Make, of 500 Tons Burthen?

Say, as 300 Ton is to 500 Ton, so is the Cube of the given Keel to the Cube of the Ship's Keel required, the Cube Root of which is 88.9 Feet. *Ans.*

And thus for the other two Dimensions, which I leave for your Practice.

And now, *Tyro*, before I leave you, I will give you a little Hint of *Measuring*, *Gauging*, *&c.* which may possibly be of Service to you, and your Acquaintance. You must expect me to be very short; but you may, by your Care and Diligence, make a better Progress.

POST-

POSTSCRIPT.

DIALOGUE XVII.

AS this little Treatiſe may fall into the Hands of ſuch Perſons in the Country, who would be glad of an Opportunity of having a Notion of meaſuring a Piece of *Timber*, a *Brick Wall*, a *Ciſtern* of *Malt*, or a common regular Field, or Piece of Land, *&c* I have (on Purpoſe for their Amuſement, and the Inſtruction of thoſe Youth that have a Fancy this Way) added this *Poſtſcript*, which, I make no Doubt, will be very acceptable to all ſuch as delight to be induſtriouſly employed at leiſure Times: And I perſuade myſelf, it muſt be very agreeable to a Parent, in either of theſe Ways of Life, to ſee his Son diligent and ready at theſe Things; which, tho' he may not meaſure ſo exact, for want of more Learning, proper Inſtruments, or Experience; yet may come near enough the Truth to give Satisfaction.

Of Flooring, Roofing, *&c.*

Queſt. 1. How many Clinkers, 6 Inches long, and 3 Inches wide, will floor a Stable 17 Feet long, and 9 Feet wide? *Anſ.* 1224.

Multiply the Length of the Stable by the Breadth, gives 153 Feet; this multiply by 144, the Square Inches in a Square Foot, gives 22032 Inches; this divide by 18, the Inches in 1 Clinker, gives 1224 *Anſ.*

Queſt.

Queſt. 2. How many Oaken Planks will floor a Barn 60 Feet $\frac{1}{2}$ long, and 33 Feet $\frac{1}{2}$ wide; when the Planks are 15 Feet long, and 15 Inches wide? *Anſ.* 108.

Multiply $60.5 \times 33.5 = 2026.75$. Then 15 Feet $\times 1.25$ Feet (*viz.*) 15 Inches) gives 18.75 Feet for 1 Plank: Now $2026.75 \div 18.75$, gives 108 Planks.

Queſt. 3. A Thatcher thatches a Barn 60 Feet long, and 25 Feet wide, and the 2 Porches are each 15 Feet long, and 10 Feet deep, I demand how many Squares are contained in it? *Anſ.* 33 Squares. *N. B.* 100 Feet is 1 Square

Multiply 60×25 gives 1500 Feet for 1 Side, which doubled, gives 3000 for both the Sides; then the Porch, *viz.* 15×10, gives 150 for 1 Side, which doubled, gives 300, which added to 3000 is 3300, which divided by 100 (that is, cutting off 2 Figures) gives 33 Squares.

2. *Of* Paving, Painting, Wainſcotting, *&c.*

Tyro. How is *Paving*, *Painting*, and *Wainſcotting* meaſured?

Philo. By the Square Yard; 9 Square Feet being 1 Yard.

Queſt. 4. A Gentleman has a Walk 22 Yards long, and 12 Feet wide, which is paved of Stone; how many Yards does it contain? *Anſ.* 88 Yards.

Firſt, multiply 22 Yards, *viz.* 66 Feet by 12, gives 792, which divide by 9, gives 88 Yards.

Queſt. 5. There is a Room 64 Feet round, and 9 Feet high, in which are two Windows, each 6 Feet high, and 3 Feet wide, and the Fire-place contains 9 Square Feet; I demand how many Yards of Paper, half Yard wide, will hang it? *Anſ.* 118 Yards.

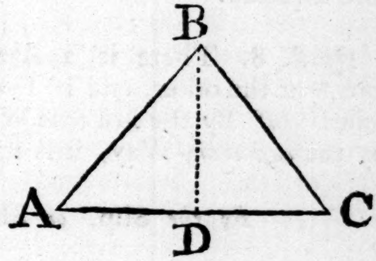
Firſt,

Firſt, $64 \times 9 = 576$ Yards, the Content, out of which take 18 Feet, each Window, *viz.* 36 Feet, and 9 the Fire-Place, is 45; and the Remainder is 531 Feet; which divide by 9, gives 59 Yards, the Content of the Room; but as the Paper is $\frac{1}{2}$ Yard wide only, it will take double this Number, *viz.* 118 Yards. *Anſ.*

Painting, Wainſcotting, &c. are done by the Yard Square, and meaſured after this Manner.

To meaſure the Peak End of a Houſe, or any Triangle.

Queſt. 6. Let *ABC* be the Peak End of a Roof, whoſe Baſe *AC* meaſures 24 Feet, and the Perpendicular Line *BD* from the Top of the Peak 16, I demand how many Square Yards it contains?



Multiply $\frac{1}{2}$ the Perpendicular *BD* by the whole Baſe, or Line *AC*; or elſe, multiply the whole Perpendicular *BD* by $\frac{1}{2}$ the Baſe *AC*, *viz.* *A. D*, or *C. D*, gives the Content in Feet, which divide by 100, gives the Squares, or by 9, gives Square Yards.

Thus *AC* 24 Feet multiplied by $\frac{1}{2}$ *BD*, 16 Feet, (*viz.* 8 Feet) gives 192 Feet, *viz.* 1 Square, 92 Feet; or divided by 9, gives 21 $\frac{3}{9}$ Square Yards of Plaiſtering. And thus for any other Triangle.

3. *Of* Board *and* Timber-Meaſure.

1. If the Board be regular, multiply the Length in Inches by the Breadth in Inches, and divide by 144, gives the Anſwer. Or, multiply the Length in Feet by the Breadth in Inches, and divide by 12, gives the Anſwer.

Queſt.

Queſt. 7. There is a Board 9 Feet long, and 10 Inches wide; how many Feet does it contain? *Anſ.* $7\frac{1}{2}$ Feet.

If the Board be wider at one End than another, the true Way is to multiply the Ends together, and extract the Square Root for a *Mean Breadth.* But Cuſtom has brought up an eaſier Way, though not ſo true, *viz.* add the Breadth of both Ends together, and take the $\frac{1}{2}$ for a *Mean Breadth*, which multiply the Length by, as before directed.

Queſt. 8. There is a Board 16 Inches at one End, and 8 at the other, and 10 Feet longer; what is the Content? *Anſ.* By the firſt true Way, it is very near $9\frac{1}{2}$ Feet; by the *cuſtomary* Way, it is 10 Feet.

By the Slip, *or* Sliding RULE.

The Seventh QUESTION *proved.*

Set the Breadth of the Board, *viz.* 10 Inches on the *Slip*, to the upper 12 above on the Rule; then againſt 9 Feet on the Rule, you have $7\frac{1}{2}$ Feet on the *Slip*, the Content required.

Again, Suppoſe a Board be 14 Feet long, and 15 Inches wide, what is the Content? Set 15 on the *Slip*, againſt the upper 12; then, againſt 14 Feet on the Rule, you have $17\frac{1}{2}$ Feet on the Slip, Anſwer.

Tyro. I underſtand you, Sir; but pray how do you meaſure Timber?

Philo. The *cuſtomary Way* is this: With a ſmall String or Cord, take the Circumference of the Tree (which is done in any Place, where the Buyer and Seller can agree) then double this String into 4 Parts, and apply it to your Rule, and that Length is called the *Girt*, or $\frac{1}{4}$ Part of the Circumference; and it is alſo cuſtomary to abate one Inch of the *Girt*, on Account of the Bark.

2. Having got the *Girt*, multiply it by itself, that is, square it, and multiply that Product by the Length of the Tree in Feet, and divide by 144, gives the Content; or multiply it by the Length in Inches, and divide by 1724, gives the Content.

Note, Few Persons mind less than $\frac{1}{2}$ a Foot in the Length of a Tree, except it be very large.

Quest. 9 There is a Tree 14 Inches *Girt*, and 9 Feet long, I demand the Content? *Ans*. 12$\frac{1}{4}$ Feet

First, 14 multiplied by 14, is 196, this ×9, the Length =1764, which divided by 144, gives 12 Feet, 36 Inches, which is $\frac{1}{4}$ of 144.

Quest. 10. There is a Tree 10 $\frac{1}{2}$ Inches *Girt*, and 12 Feet $\frac{1}{2}$ long, I demand the Content? *Ans*. 9$\frac{1}{2}$ Feet. For 10.5+10.5=110.25×12 5=1378.125÷144=9.57 Feet, or 9 Feet, 82 Inches. *Ans*.

By the Slip, *or* Sliding RULE.

The Ninth QUESTION *proved*.

Set the Length of the Tree on the Slip (*viz*. 9 Feet) against 12 in the Middle of the Rule (wrote *Girt Line*) then against the *Girt* (*viz*. 14) on the *Girt Line*, you have 12 $\frac{1}{2}$ Feet on the Slip.

The Tenth QUESTION *proved*.

Set 12$\frac{1}{2}$, the Length, against 12, the *Girt Line*; then against 10$\frac{1}{2}$, you have better than 9$\frac{1}{2}$ on the *Slip* itself, *viz*. 9 Feet, 82 Inches.

Of tapering TIMBER.

Some Persons will take but one *Girt*, though a Tree be very long and tapering; but this is certainly very wrong,

wrong, as it may do Injuſtice to either the Buyer or Seller. The beſt Way is, to meaſure ſuch a Tree, as if it were two or three diſtinct Trees, by taking two or three ſeveral Lengths and Girts.

Some, indeed, take 2 *Girts*, one at the great, and the other at the ſmall End, and add them together, and take the $\frac{1}{2}$ of it for a *Mean Girt* (as in *Board-Meaſure*) but this is a Hurt to the Buyer, and very erroneous; whereas they ſhould multiply one *Girt* by the other, and extract the Square Root for a *Mean Girt*.

Queſt. 11. Suppoſe a Tree 20 Inches *Girt*, at one End, and 40 at the other, and 9 Feet long, I demand the Content?

By the cuſtomary Way the *Mean Girt* will be 30 Inches, and the Content will be 56 Feet, 36 Inches $=\frac{1}{4}$ of another Foot. But, according to the true Way, the *Mean Girt* is but 28.28, and the Content but 49.98 Feet, *viz.* 49 Feet, 141 Inches, which is 6 Feet 39 Inches leſs than the other.

Tyro. This is a ſenſible Difference, indeed, in many Loads of Timber.

Philo. Very true.

Note 1. In ſome Counties, 40 Feet make a Load, and in others, 50 Feet make a Load.

Note 2. When there are 50 Feet to the Load, then to caſt up the Content, at any given Price, the Rule is, Multiply the Content, or Number of Feet, by the Price in Shillings, and cut off the three firſt Figures, from the Right to the Left-hand: So will the Figures towards the Left-hand be Pounds Sterling, and the other will be Decimal Parts of a £.

EXAMPLE.

Queſt. 12. Suppoſe I meaſured 6 Trees, and their Content be 548 Feet, at £1 – 10*s. per* Load?

I mul-

I multiply 548 by 30, and it gives 16440, which I cut off thus, 16|440, and it is £. 16.440, *viz.* £.16. 8*s.* 9*d.* $\frac{1}{2}$.

N. B. Stone is meaſured the ſame, only obſerve, 8 Inches make 1 Foot of Stone.

4. *Of* BRICK-WORK.

Tyro. How is *Brick-work* meaſured ?

Philo. By the *Square Rod*, that is, 16 Feet $\frac{1}{2}$ in Length, and 16 $\frac{1}{2}$ in Breadth, make 272 $\frac{1}{4}$ Feet, or 1 Square Rod ; but, for common Practice, 272 Feet only is ſufficient.

Tyro. Is there not a certain Standard for the Thickneſs of Brick-work ?

Philo. Yes : All Sorts of Brick-work is reduced to the Standard of 1$\frac{1}{2}$ Brick thick, of which I ſhall give you a further Notion by and by.

1. *Of Work* at 1$\frac{1}{2}$ *Brick thick, the Standard.*

Multiply the Length by the Height, in Feet, and divide by 272, the Quotient gives the Square Rods, and the Remainder, the Feet, or Parts of a Rod.

Queſt. 13. A Gentleman built a Brick Wall round his Garden, which was 998 Feet long, 9 Feet high, and 1$\frac{1}{2}$ Brick in Thickneſs : I demand how many Rods it contains. *Anſ.* 33 Rods, 6 Feet.

Here I multiply 998, the Length, by 9, the Height, and it gives 8982 Feet, which I divide by 272, (the Feet in a Rod) and it gives 33 Rods, 6 Feet. *Anſ.*

Tyro. I underſtand it ; this is eaſy enough : But ſuppoſe it was but 1 Brick thick, or ſuppoſe it were 2, or 3 Bricks thick, how then ?

Philo. Having found the Content, at 1$\frac{1}{2}$ Brick thick, as before directed, ſay thus :

As 3 (the $\frac{1}{2}$ Bricks in the Standard Meaſure) is to the Content in Standard Meaſure, at $1\frac{1}{2}$ Brick thick, ſo is the Number of half Bricks in the Wall to the Content, at that Thickneſs.

Queſt. 14. There is a Brick Wall 998 Feet round, and 9 Feet high, what is the Content, at $2\frac{1}{2}$ Brick thick?

The Content, at $1\frac{1}{2}$ thick, was found in the laſt Queſtion to be 33 Rods, 6 Feet. Say therefore,

As 3 to 33.6, ſo is 5 half Bricks, *viz.* the Thickneſs, at $2\frac{1}{2}$ Bricks thick to the Content, at that Thickneſs, *viz.* 55 Rod, 10 Feet.

Tyro. I underſtand you well; but cannot any Thickneſs be done at one Operation?

Philo. Yes; for having multiplied the Length by the Height, divide by any of the following Numbers, that are ſet againſt the given Thickneſs, and you have the Content in Rods at once, and the Remainder is Feet.

Note, Though there be Decimals in the *Diviſors*, you may divide by the whole Numbers for common Uſe.

For … Brick thick	divide by
1	408.3
$1\frac{1}{2}$	272.25
2	204.2
$2\frac{1}{2}$	163.3
3	136.12
$3\frac{1}{2}$	116.6
4	102.1
$4\frac{1}{2}$	90.7
5	81.7

Queſt. 14. There is a Wall 15.5 Feet long, and 9.5 Feet high; what is the Content, at $3\frac{1}{2}$ Bricks thick? *Anſ.* 1 Rod, 2 Tenths: For I multiply $15.5 \times 9.5 = 147.25$, which divided by 116.6 the *Diviſor* for $3\frac{1}{2}$ Bricks, gives 1 Rod, 2 Tenths. And thus for any Thickneſs; for at $4\frac{1}{2}$ thick, it is 1.5 Rod, *viz.* $1\frac{1}{2}$.

By

By the Slip, *or* Sliding RULE.

There is a Wall 9 Feet high, and 76 Feet long, and $1\frac{1}{2}$ Brick thick; I demand the Content? *Ans.* 2 Rods, 140 Feet, or better than $2\frac{1}{2}$ Rods.

Set 272 on the Slip to the Heighth 9 above it; then against 76, the Length on the Slip, is $2\frac{1}{2}$, or better, on the Rule.

A RULE *for any Thickneſs.*

Set any of the former *Diviſors*, anſwering any Thickneſs on the Slip, to the Heighth; then againſt the Length is the Anſwer. Thus the ſame Wall, at 3 Bricks thick.

Set 136 to 9, then againſt 76 you have 5 Rods, the Content, at 3 Bricks thick.

5. *Of* SURVEYING.

Tyro. How is Land ſurveyed?

Philo. Land-Meaſure is a Part of the Mathematics, and to ſurvey it true, and in a maſterly Manner, you ſhould be provided, 1. With a Chain, called *Gunter's Chain*. 2. A *Caſe of Inſtruments*. 3. A *Parallel Ruler*. 4. A *plain Table*. 5. A *Platting-Scale*, or *Protractor*. And, to make it more complete, a *Theodolite*.

Tyro. But cannot I meaſure a common regular Field, or little Piece of Ground, without all theſe Inſtruments?

Philo. Yes; by a Chain only, or, for want of that, a Cord, a Rod-Pole, or any ſuch Thing; but this muſt not be depended upon for Truth.

Tyro. Give me a Deſcription of the Chain.

Philo. All Land is now generally meaſured by a Chain, containing 4 Rods, or Poles, in Length, (*viz.* 22 Yards) according to a Statute made in the 33d of *Edward* I. *Anno* 1305, which ſays, *That a Square Acre ſhall contain* 160 *Rods, viz.* 40 Rods in Length, and 4 Rods in Breadth, make 160 Rods, or 1 Acre of Ground.

Note, The *Chain* is made of Iron, containing 100 Links, each in Length is 7.92 Inches, (or nearly 8 Inches) 100 of which is 792 Inches, or 22 Yards, (*viz.* 4 Rods.) Therefore, 1 Chain in Length, and 10 in Breadth, or 10 in Length, and 1 in Breadth, make an Acre.

Note 2. For want of a Chain you may take a Cord 22 Yards, or 4 Rods long, or any Number of Rods long you please, dividing it into Halves and Quarters, with which you may measure any common Field within a Trifle of Truth, or, at least, for common Satisfaction.

Having provided yourself with a Chain, or any convenient Line, if the Field, or Piece of Ground, be regular, *viz.* a Square, or the opposite Sides alike; then measure the Length and the Breadth, in Rods, or Parts, and multiply the Length by the Breadth, and divide the Product by 160, the Rods in an Acre, you have the Content.

Quest. 5. There is a Field in the Form of a long Square (called a Parallelogram) whose Length is 35 Rods, and Breadth 24 Rods; I demand the Content in Acres? *Ans.* 5 Acres, 1 Rood.

First, I multiply 35, the Length, by 24, the Breadth, and it gives 840 Rods; which I divide by 160, gives 5 Acres, and 40 remains, which I multiply by 4 (because 4 Roods make 1 Acre), and divide again by 160, gives 1 Rood.

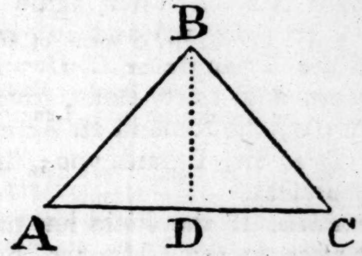
Quest. 16. There is a Square Piece of Ground set out upon a Heath, or Common, in order to form a Camp for 1000 Soldiers, each Side contain 60 Rods; how many Acres does it contain? *Ans.* $22\frac{1}{4}$ Acres.

For $60 \times 60 = 3600$, which divided by $160 = 22$ Acres, 80 Rods, or $22\frac{1}{2}$ Acres.

Quest. 17. There is a 3 sided or triangular Field, *A B C*, the Side *A C* is 51.5 Rods, and the Perpendicular *B D* is 34 Rods; how many Acres does it contain? *Ans.* $5\frac{1}{2}$ Acres nearly.

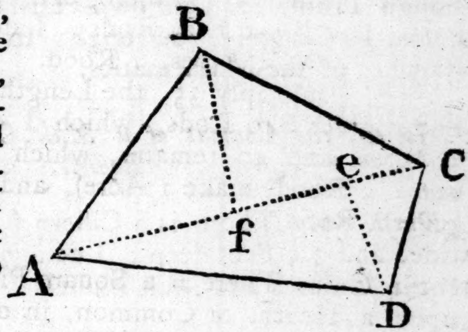
Note,

Note, You must first of all measure the Side from *A* to *C*, called the Base, which suppose $51\frac{1}{2}$ Rods; then measure half Way from *A* to *C*, and from *D* measure straight up to the Point *B*, which is called the Perpendicular, which suppose to be 34 Rods: Now, I told you before, that the Base multiplied by $\frac{1}{2}$ the Perpendicular gives the Content; that is, 51.5 multiplied by 17 ($\frac{1}{2}$ the Perpendicular) gives 875.5, which divided by 160, gives 5.47 Acres; that is, very near $5\frac{1}{2}$ Acres.



To measure any four-sided Field, whose Sides are unequal, called a Trapezium.

Quest. 18. There is a *Trapezium*, or four-sided Field, or Piece of Ground, *A B C D*, whose Base *A C* is 64 Rods, and the Perpendicular *B f* is 60, and the other Perpendicular *D e* is 40: I demand the Content in Acres? *Ans.* 20 Acres.



First, To measure this Field, go straight cross it from the Corner *A* to the Corner *C*, which here is called the Base, and measures 64 Rods: Then measure right straight from the Point *B* to *f*, which is 60 Rods, and right straight from *D* to *e*, which is 40 Rods. This done, the Rule is,

Multiply the whole Base *A C* 64 by $\frac{1}{2}$ *B f* 60, (*viz.* 30) and it gives 1920 Rods, the Content of the Triangle

angle *ABC*: Then again multiply the Base *AC* by $\frac{1}{2}$ *De* 40 (*viz.* 20) and it gives 1280 Rods, the Content of the Triangle *A C D*. Add those 2 together, *viz.* 1920, and 1280 Rods, gives 3200 Rods, which divide by 160, the Rods in an Acre, gives 20 for the Answer.

Tyro. Sir, I thank you; this is enough for my Purpose at present.

Philo. If the Field has more Sides, you may measure it after the same Manner, by dividing it into Triangles, always remembering to multiply the Base by $\frac{1}{2}$ every Perpendicular that falls upon it.

5. *Of* GAUGING.

Tyro. How may I *gauge*, or tell the Content of any common Cooler, or regular Cask, or Cistern, in Gallons, or Bushels.

Philo. I shall give you some short Instructions, by which you may tell the Content of several Things near enough Truth, for your own Satisfaction: But to be a practical *Gauger*, you ought to understand several Branches of the Mathematics.

1. *To tell the Content of a Malt Cistern in Gallons and Bushels.*

Quest. 19. There is a Cistern 6.5 Feet long, 4 Feet wide, and 3.5 Feet deep: I demand its *Area*, and Content in Gallons and Malt Bushels?

Note 1. *Area* signifies the superficial Content, or Content at one Inch deep; which multiplied by the Depth, gives the Content itself.

Note 2. That 282 Inches make 1 Gallon of Ale, Water, *&c.* 231 a Gallon of Wine, and 2150 Inches 1 Bushel, which are your Divisors for all regular Figures.

RULE.

RULE.

Multiply the Length, 78 Inches, by the Breadth, 48, and it gives 3744 Inches, which divide by 282, gives 13.276, the Area, at 1 Inch deep, or divide by 2150, gives 1.741, the Area in Bushels. The Area multiplied by the Depth, 42 Inches, gives 557.592 Gallons. The Area for *Malt* multiplied by 42, gives 73.122, the Content in Bushels.

Note, If the Area be not required, or you do not understand Decimals, you may more easily find the Content at once, thus: Multiply the Length, Breadth, and Depth, in Inches together, gives 157248, which divide by 282, gives 557 Gallons $\frac{1}{2}$, or 157248 divided by 2150, gives 73 Bushels $\frac{1}{10}$ as before.

To find the AREA *by the* Sliding Rule.

Set 282 upon *B* to 48, the Breadth on *A*; then against 78, the Length on *B*, is 13.276, the Area in Gallons.

For *Malt*, Set 2150 on *B* to 48 on *A*; then against 78, the Length on *B*, is 1.741 on *A*, the Area in Bushels: And thus for any regular Figure.

To gauge a Tub or Cooler in the Form of a Cylinder, viz. *whose top and bottom Diameters are equal.*

RULE.

Square the Diameter, *viz.* multiply it by itself, and this Product by the Depth, then divide by 359 for Beer Gallons, 294 for Wine, and 2737, (or rather by 2737 47) for Malt.

Quest.

Quest. 20. There is a Tub 4 Feet, 2 Inches Diameter, and 3 Feet, 4 Inches, deep: I demand the Content in Beer, Wine, and Malt?

I ſquare the Diameter 50, which is 2500, and multiply this by the Depth, 40 Inches, gives 100000; which divide by 359, gives 278 Ale Gallons; divide by 294, gives 340 Wine Gallons, and by 2737 only, gives 36.5 Malt Buſhels.

Note, If the Figure be the Form of a *Triangle,* or *Trapezium* (as in *Queſtion* 17 and 18) you muſt proceed to meaſure them as there directed, and after having multiplied by the Depth, divide by 282 for Beer, 231 for Wine, and 2150 for Malt, gives the Content.

Queſt. 21. There is a Tub, whoſe Top Diameter is 40 Inches, Bottom 30 Inches, and the Depth 60 Inches: I demand the Content in Beer, Wine, and Malt?

There are ſeveral Ways to do this. One is this, multiply the Diameters together, and extract the Square Root for a mean Diameter, which is here 34.64. This multiplied by itſelf, and divided by 359, gives the Content in Gallons, or by 2737, gives the Malt Buſhels.

Or more eaſily thus, though not ſo true.

Add the Diameters together, and take the $\frac{1}{2}$ for a *Mean,* is 35. Now $35 \times 35 = 1225 \times 60 = 73500$, which divided by 359, gives about 205 Gallons; and ſo for Malt, *viz.* gives 26 Buſhels $\frac{8}{10}$.

For a Couch of MALT.

1. If it be a regular Square only, multiply the Length, Breadth, and Depth together, and divide by 2150, gives the Buſhels.

2. If

2. If it be a *Triangle*, or *Trapezium*, proceed as before directed, and divide still by 2150.

Tyro. But suppose the Couch be uneven, how shall I tell where to take the Depth?

Philo. Take the Depth at 4 or 5 Places, add them all together, and divide by the Number of Places you took the Depth at, for a mean Depth.

Quest. 22. There is a Bed, or Couch of Malt, in the Form of a long Square, whose Length is 35 Feet, Breadth 16 Feet, and I find the mean Depth to be 8.5 Inches, *viz*. $8\frac{1}{2}$ Inches; I demand the Content.

Thus, 420 Inches $\times 192 = 80640 \times 8.5 = 685440$; this divided by 2150, gives 318.8 Bushels.

Of Cask Gauging.

There is a great Variety in gauging Casks; but the following Methods will be near enough Truth for all common Casks, such as Barrels, Butts, *&c*. that are pretty much bulged.

First, Having taken the Bung and Head Diameters, the Rule is, To the Sum and $\frac{1}{2}$ the Sum of the Squares of the Bung, and Head Diameters, add $\frac{1}{2}$ the Difference of the said Squares: This Sum multiply by the Length, and divide by 1077 for Beer, and 882 for Wine Gallons.

2. *Rule*, which is as true, and much easier.

To the double Square of the Bung Diameter add the Square of the Head Diameter; then multiply this Sum by the Length of the Cask, and divide by 1077 for Beer, or 882 for Wine.

Quest. 23 There is a Cask, whose Bung Diameter is 28 Inches, Head Diameter 25 Inches, Length 36: I demand the Content in Ale Gallons?

First,

First, The Square of the Bung Diameter 28 is 784; which doubled is 1568. Then the Square of the Head, *viz.* 25×25=625, which added to 1568, is 2193; this ×36, the Length is 78948, which divided by 1077, gives 73 Gallons, 2 Pints, for Beer, and divided by 882, gives $89\frac{1}{2}$ Gallons, Wine or Brandy.

Note 1. If you find the Area of the Bung, and Head Diameters (by *Question* 20) and add twice the *Area* of the Bung, *viz.* 2.184 to the *Area* of the Head 1.741 it is 6.109, which multiplied by $\frac{1}{3}$ of the Cask's Length, *viz.* 12, gives 73.308 Gallons, as before.

These Methods holding good for most Casks, I shall give no more Examples.

Note 2. If one of the Head Diameters be larger than the other, and the Cask is straight in the Sides, like some Churns, then (by *Question* 21) find a mean Diameter throughout, and proceed as therein directed.

6. *Of* Cross Multiplication.

There are two Methods.

1. *By* Multiplication *only*.

1. *Rule.* Feet multiplied by Feet produce Feet.

2. Inches multiplied by Feet, or Feet by Inches, produce Inches.

3. Inches multiplied by Inches produce Parts.

Note, 12 Seconds make 1 Part, 12 Parts make 1 Inch, and 12 Inches 1 Foot.

2. *By* Multiplication *and* Division.

Rule 2. Having placed the smallest Sum for the Multiplier, multiply the very last Place of the Multiplicand towards

towards the Right-hand by the firſt Place, or Name of the Multiplier, and carry 1 for every 12, ſetting down what is over 12 under the Part you multiplied, then take the Parts of the Multiplier as in *Practice*, carrying as before 1 for every 12.

But an Example will render it more eaſy, if I give it both Ways.

	Feet	*In.*	*Parts*		*Feet*	*In.*
Multiply	4	3	6	*by*	4	3
by	4	3				
	17	2	-			
	1	-	9			
			1	6		
Anſ.	18	2	10	6		
	F.	*In.*	*P.*	*Sec.*		

Firſt, I begin and multiply the Top 4 Feet, 3 Inches, and 6 Parts, by 4 Feet, (carrying 1 for every 12) ſaying, 4 Times 6 is 24 Parts, that is, 0 and carry 2; then 4 Times 3 is 12, and 2 I carried is 14 Inches, that is 2 Inches, and carry 1 to the Feet; then 4 Times 4 is 16 Feet, and 1 is 17.

Secondly, I multiply now 4 Feet, 3 Inches, 6 Parts, by the lower 3 Inches, ſaying, 3 Times 4 is 12 Inches (becauſe Feet multiplied by Inches are Inches) then 3 Times 3 Inches is 9 Parts (for Inches by Inches produce Parts) and *laſtly*, 3 Times 6 Parts is 18 Parts, *viz.* 1 Part, 6 Seconds.

The Second Method.

I firſt multiply the firſt or top Line as before, and find it as before, 17-2-0; and now I take the Parts as in *Practice*, ſaying, 3 Inches is $\frac{1}{4}$ of a Foot, &c. *See the Work.*

Feet

		Feet	*In.*	*P.*	
		4	3	6	
		4	3		
In.	$\frac{1}{4}$	17	2	–	
3		1	–	10	6
		18	2	10	6 *as before.*

I say, 3 Inches is $\frac{1}{4}$ of a Foot, and take the Parts from 4 Feet, 3 Inches, 6 Parts, saying, the 4th of 4 is 1 Foot; then the 4th of 3 Inches 6 Parts, (*viz.* 42 Parts) is 10 Times (4 is 40) and 2 Parts over; *lastly*, I say the 4th of 2 Parts (*viz.* 24 Seconds) is 6 Seconds; so have I now done it in two Lines only.

And now, *Tyro*, I must bid you farewel, and I hope you will take Care to improve yourself in them, rather than trifling away your Time with idle Fancies: For it is evident, that the Knowledge of *Arithmetic* is necessary in every Station of Life, since almost all Manner of Business depends upon it: And not only this, *Tyro*, but it is a great Help to protect us against the Frowns of Fortune, and keep us (by being qualified for some lawful Post, or Employment) from those common Temptations and Misfortunes, to which those, who know the Want of it, so often fall into, and pay for so dearly.

Tyro. I return you Thanks for this Advice, and hope I shall make such Use of it as may not frustrate your good Designs.

Philo. I make no Doubt but you will. And therefore ——— I once more bid you an hearty Farewel.

Tyro. Sir, I am your humble Servant.

FINIS.